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SYNTHESIS OF AROMATIC MONAMINES BY INTRAMOLECULAR ATOMIC INTERCHANGE.*

By A. W. HOFMANN, M.D., LL.D., F.R.S.

In a paper submitted to the German Chemical Society about a year ago, we proved (Dr. Martius and myself†) that the action of methylic alcohol on aniline chlorhydrate at a high temperature and under pressure, far from yielding exclusively methyl- and dimethylaniline, as has been formerly believed, is capable of causing methylation of the phenyl group, and thus producing quite a series of higher homologues of dimethylaniline.

If we endeavour to gain an insight into the mechanism of this reaction, we are led to assume that in the first instance the chlorhydric acid of the aniline salt gives rise to the formation of methylic chloride, which in its turn induces substitution, first in the ammonia fragment, and ultimately in the phenyl group itself. If, on the other hand, we remember that a tertiary monamine, such as must be formed by the final methylation of the ammonia fragment in aniline when submitted to the action of an alcohol chloride, is invariably converted into an ammonium compound, it must appear rather strange that in the process above alluded to only tertiary, and never any quartary bases are observed.

Under these circumstances the idea very naturally suggested itself of submitting the behaviour of quartary compounds at a high temperature under pressure to an experimental investigation.

The simplest compound that could be detected for such an inquiry appeared to be trimethylphenylammonium iodide, $C_6H_5.CH_3.CH_3.CH_3NI$.

Reserving for a future communication the experimental details of this inquiry, I will limit myself for the present to a brief statement of the principal result obtained.

Leaving secondary reactions out of consideration, the transformation of the trimethylated phenylammonium iodide is represented by the following equations :—

Transformation of quartary into tertiary compound.

$$C_6H_5.CH_3.CH_3.CH_3.NI = (C_6H_4.CH_3)CH_3.CH_3N.HI.$$

Transformation of tertiary into secondary compound.

$$(C_6H_4.CH_3)CH_3.CH_3.N.HI = \\ = C_6H_3(CH_3(CH_3)_2]\,CH_3.HN.HI.$$

Transformation of secondary into primary compound.

$$[C_6H_3(CH_3)_2]\,CH_3.HN.HI = [C_6H_2(CH_3)_3]\,HHN.HI.$$

Accordingly trimethylated phenylammonium iodide, when submitted to the action of heat, is transformed in the first place into iodhydrate of dimethylated methylophenylamine or dimethyl toluidine; this, in a second phase of the reaction, becomes iodhydrate of monomethylated dimethylophenylamine or xylidine, which in its turn is ultimately converted into iodhydrate of trimethylophenylamine, *i.e.*, of cumidine. The essential character of the reaction is thus seen to be an intermolecular change in the position of the methyl groups. According to the duration of the process, there are incorporated in the benzol nucleus, first the methyl group of the alcohol iodide, and then successively the two methylic groups which are stationed in the ammonia fragments. The action of heat on the quartary ammonium compound thus places at our disposal a simple means of rising from the benzol series itself to the toluol-, xylol-, and cumol series, or, generally (for the reaction may probably be utilised in many other cases), of passing from a less carbonated to a more carbonated series of compounds.

In carrying out the researches, the general results of which are sketched in the preceding paragraphs, rather considerable quantities of trimethylated phenylammonium iodide were consumed. This I obtained partly by methylating pure aniline with methyl iodine, partly by starting from commercial dimethylaniline, which was most liberally supplied to me by my friends Dr. D. Martius and Mendelssohn Bartholdy, having been specially purified for this purpose by Mr. G. Krell, by fractional distillation in the laboratory of the factory. This purified material was found to boil between 192° and 200°; and only few rectifications were necessary in order to obtain from it dimethyaniline in a state of perfect purity, identical in every respect with the base prepared by submitting trimethylated phenylammonium hydrate to distillation. Pure dimethylaniline is a liquid of 0·9553 V.W., solidifying to a crystalline mass at +0·5°, and boiling at 192°. The boiling-point was repeatedly determined, since it had been erroneously stated by M. Louth* to be 202°. The nature of the compound was ascertained by the analysis of the beautiful platinum-salt $2[C_6H_5(CH_3)_2N.HCl].PtCl_4$, crystallising in well-formed tables of considerable solubility.

In the early experiments trimethylated phenylammonium iodide was employed in the pure state, such as is obtained by crystallisation; subsequently, however, it was found to be quite sufficient if 1 mol. of dimethylaniline was mixed with 1 mol. of methyl iodide, and the compound thus produced at once submitted to the action of heat.

The quartary iodides may be exposed to a temperature of 200° for a considerable time without undergoing any alteration; but when heated for a day to from 220° to 230°, the salt is changed, the whole crystalline compound

* A paper read before the Royal Society.
† Hofmann and Martius, *Bericht*, 1871, p. 742.

* Louth, *Bull. Soc. Chim.* (2) vol. vii., page 448.

being transformed into an amber-yellow viscid mass, exhibiting no longer a trace of crystalline structure. If the temperature be then raised to the melting-point of lead (335°) a further change is manifested by the amorphous resinous substances having solidified again to a hard mass of large radiated, generally rather coloured crystals. On opening the digestion-tubes, appreciable quantities of uninflammable gas are evolved.

The products formed at moderate and extreme temperatures essentially differ from one another. This is seen at once when the iodhydrates produced in both cases are decomposed by alkali, and the bases thus liberated are submitted to distillation in a current of steam. The volatility of these bases shows the absence of quartary compounds; but whilst the monamines formed at moderate temperatures unite with acids to an extremely soluble salt, which are scarcely to be crystallised, those which are produced at high temperatures are found to solidify to rather difficultly soluble (readily crystallisable) salts with acids. The former bases exhibit the characters of *tertiary* and *secondary*, the latter ones those of *primary* monamines. Under these circumstances, it appeared desirable separately to examine the products formed in different conditions of temperature.

Examination of the Monamines formed at moderately High Temperatures.

On submitting the iodhydrates formed at 220°—230° to distillation with alkali, a basic oil is obtained, which, when rectified after drying over hydrate of potassium, boils between 200° and 280°. By repeated distillation, the boiling-point is considerably lowered, small quantities of substances boiling beyond the range of the thermometer being separated. Finally, by far the greater portion of the bases is found to pass between 186° and 220°. This liquid consists of two varieties of dimethyltoluidine, of methylxylidine, and small quantities of dimethylxylidine. Of the two dimethyltoluidines, the one has the V.W. 0·9324, and boils constantly at 186°: the other has the V.W. 0·9368, and boils at 205°, *i.e.* 19° higher than the former one. The nature of these two bases was fixed by the analysis of their platinum-salts,

$$2[C_6H_4.CH_3)(CH_3)_2N.HCl].PtCl_4,$$

and also of the quartary iodide, $(C_6H_4.CH_3)(CH_3)_3NI$, into which they were converted by the action of methyl iodides, and the platinum-salts corresponding to these iodide, $2[(C_6H_4.CH_3)(CH_3)_3NCl].PtCl_4$. The two dimethylated toluidines here described obviously correspond to two of the three modifications of toluidine, and very probably to the two liquid modifications. Dimethyltoluidine, obtained by converting solid toluidine into the trimethylated toluyl ammonium iodide, and then submitting the corresponding hydrate to distillation, has a V.W. 0·988, and boils at 210°. The substance thus obtained, the composition of which was also established by analyses of the platinum-salt, essentially differs from the isomeric base boiling at 186°; it is less easily distinguished from the base boiling at 205°, with which more particularly it much agrees in odour; in fact these two compounds exhibit only the slight difference of 5° in their boiling-point. Still I believe them to be isomeric, not identical.

It deserves to be noticed that while the boiling-point of solid toluidine (202°), by the introduction of two methyl groups, is raised by 8°, the boiling temperature of one of the liquid modifications (198°) is lowered by not less than 12°. Phenomena of this kind have been observed repeatedly in the course of this inquiry.

It was mentioned already that, in addition to the two dimethylated toluidines, the products of the action of heat on trimethylated phenylammonium iodide contains methylxylidine. I have not been able to isolate this compound; but it was not difficult to prove its presence by the action of methyl iodide on the mixed bases. The two dimethylated toluidines are thus converted into quartary iodides; but, together with these compounds, there is formed a tertiary iodhydrate, the base of which is readily separated by distillation of the product with an alkali. The base thus liberated has the V.W. 0·9293, and boils at 196°. Analyses of the platinum-salt proved it to be dimethylated xylidine,

$$C_{10}H_{15}N = [C_6H_3(CH_3)_2](CH_3)_2N,$$

which previous to methylation must have obviously existed in the form of monomethylated xylidine,

$$C_9H_{13}N.[C_6H_3(CH_3)_2]CH_3.HN.$$

The presence of methylxylidine being only indirectly proved by analysis of the dimethylated base, it appeared desirable to establish the nature of the latter by additional experiments. For this purpose the tertiary monamine was converted, by means of methyl iodide, into the quartary compound, the characters of which could not be mistaken, its composition being, moreover, established by analysis of the beautiful platinum-salts.

$$2[C_6H_3(CH_3)_2)](CH_3)_3NCl].PtCl_4.$$

In performing these experiments I was astonished to observe how difficultly dimethylxylidine combined with methyl iodide. Digestion at 100° produced no effect, and only heating the mixture for many hours to a temperature of 150° combination took place, but even then only to a very small extent.

It was this indifference of dimethylxylidine towards methyl iodide which enabled me to discover that small quantities of this compound are always formed, together with the monomethylated xylidine, when trimethylated phenylammoninm iodide is submitted to the action of heat. On treating the liquid, chiefly consisting of the two dimethylated toluidines and of monomethylated xylidine, with methyl iodide, these bases, as I have pointed out, are converted into iodine compounds; the small quantity of dimethylxylidine, which as such exists in the liquid, remains behind with the excess of methylic iodide, from which it may easily be separated by means of hydrochloric acid.

The formation of dimethylated toluidines and of monomethylated xylidine, requires no special explanation; it is due to intramolecular atomic interchange.

$$\begin{aligned} C_6H_5(CH_3)_3NI &= (C_6H_4\,.\,CH_3)\ (CH_3)_2\ N.HI. \\ &= [C_6H_4\,.\,(CH_3)_2]CH_3HN.HI. \end{aligned}$$

For the generation of dimethylxylidine it is necessary to supply a methyl group from without. I have, however, already pointed out that, along with the principal transformation, several secondary reactions are taking place; those I hope to examine more minutely by-and-bye. Dimethylxylidine, which occurs in comparatively small quantity, obviously belongs to such a secondary change. The complementary product is probably monomethyltoluidine,

$$\begin{aligned} [C_6H_5(CH_3)_3NI] &= (C_6H_4.CH_3)CH_3HN.HI, \\ &+ [C_6H_4.(CH_3)_2](CH_3)_2N.HI, \end{aligned}$$

which I have not, however, as yet been able to trace.

Whilst engaged with these experiments, I have, for the sake of comparison, converted a specimen of xylidine obtained from aniline-oil of high boiling-point into dimethylxylidine. The xylidine employed had constant boiling at 216°. The tertiary base procured from it was observed to boil at 203°, *i.e.*, 7° higher than the compound derived from trimethylated phenylammonium iodide; from this last derivative it differed, moreover, by combining much more readily with methyl iodide. The quartary compound thus formed often remains liquid for days, and then suddenly solidifies into a beautiful mass of crystals.

Examination of the Monamines formed at High Temperature.

It has been already stated that the bases into which trimethylated phenylammonium iodide is converted at

very high temperatures (melting-point of lead), unmistakably exhibit the character of primary monamines. The only primary base which can arise from trimethylated phenylammonium iodide by intramolecular atomic interchange is a trimethylophenylated monamine, *i.e.*, a cumidine, $C_6H_5(CH_3)_3NI = [C_6H_2(CH_3)_3]H_2N.HI$. This, I may at once observe, is indeed the principal product of the reaction. It cannot, however, be wondered at that, under the influence of such extreme temperatures, many collateral changes must take place. The presence of dye-products is at once perceived, when the crystalline contents of the digestion tubes are submitted to distillation in a current of steam. Together with the vapour of water, a colourless oil is volatilised, consisting of hydrocarbons partly solid, partly liquid, the examination of which will form the subject of a future communication. Addition of an alkali to the liquid in the retort liberates considerable quantities of monamines, which, when dried over iodiamhydrate, are observed to boil between 225° and 260°. By repeated distillation this range of boiling is still considerably expanded; at the same time, by far the largest portion of the liquid is found to pass between 217° and 230°. The primary nature of this main fraction not only, but also of the bases, having both a lower and higher boiling-point, is at once manifested by the crystallising power and insolubility of the salts which they produce. At whatever stage of the distillation a drop of the liquid passing be mixed with dilute hydrochloric or nitric acid (invariably splendid), needles of chorhydrate or nitrates are formed, the solutions of which, even when considerably diluted, solidify with platinum perchloride double salts generally well crystallised. Another experiment rapidly indicating the primary character of these monamines may here be mentioned. On adding benzoyl chloride to the several basic fractions, much heat is evolved, and after cooling crystalline masses are produced, which are separated by water into soluble chlorhydrates and insoluble benzol compounds remaining behind, which may be crystallised from alcohol. None of the many secondary and tertiary monamines which have passed through my hands in the course of this inquiry exhibit this deportment, and accordingly benzoyl chloride may be recommended as a valuable reagent, readily applicable for primary bases. The method of recognising primary monamines which I have pointed out some time ago,* and which consists in converting them, by means of alcoholic potash and chloroform, into the powerfully smelling isonitrites, may also with advantage be resorted to.

The liquid boiling between 217° and 230° was separated by distillation into four fractions, each of which was then converted into a magnificently crystalline chlorhydrate. These several salts, after re-crystallisation, were all found to contain $[C_6H_2(CH_3)_3]H_2N.HCl$, and to yield platinum-salt of the composition

$$2\,[[C_6H_2(CH_3)_3]\,H_2.N.HCl]\,.PtCl_4.$$

I was thus led to believe that the fraction boiling between 217° and 230° consisted of several isomeric cumidines; but on separating the bases from the several chlorhydrates, it was found that they all contributed very nearly the same boiling-points. The liquid thus obtained boiled between 225° and 227°, and had the V.W. 0·9633; it did not solidify when exposed to a temperature of −10°. I am therefore inclined to assume that only one cumidine is formed by the action of heat on trimethylated phenylammonium iodide, and that the irregularities in the boiling-point of the original fraction must be due to the presence of small quantities of impurities.

It deserves to be noticed that cumidine obtained from aniline, when heated with corrosive sublimate, yields no trace of red colouring-matter, whilst a splendid crimson is at once produced if a mixture of this base with pure aniline be treated. I reserve for a future communication the study of the colouring-matter thus obtained.

* Hofmann, *D. Chem. Berichte*, 1870, p. 767.

Taking into consideration the general observations recorded in the preceding paragraphs, the compound here designated as cumidine was naturally assumed to be a primary monamine. Little doubt as this conception appeared to present, it had nevertheless to be proved by experiment; for this purpose the base was submitted to methylation. Cumidine is readily acted upon by methylic iodide at the common temperature. Since it was only necessary to establish the degree of substitution the first product of methylation was at once submitted to a second treatment; this second methylation likewise commenced at the common temperature, but had to be finished in the water-bath. The dimethylated base thus obtained has the V.W. 0·9076; it boiled between 213° and 214°; hence, in this case also, the insertion of two methyl groups had lowered the boiling-point. Dimethyl cumidine may be cooled to −10° without solidifying; like all tertiary monamines, it forms very soluble salts, but gives a very beautiful platinum salt, containing

$$2\,[[C_6H_2(CH_3)_3]\,(CH_3)_2N.HCl]\,.PtCl.$$

Remarkably enough, dimethylated cumidine exhibits the same reluctance to form a quartary compound with methyliodide that has already been pointed out as a peculiarity of the tertiary xylidine. But whilst in the case of dimethylxylidine, though difficultly and sparingly, combination after all took place, all attempts with dimethylated cumidine have hitherto failed. The base was heated with methylic iodide for days in the water-bath, and ultimately even to 150° without any result. This inability of forming quartary compounds must in one way or another depend upon the arrangements of the material within the molecule. At all events, it deserves to be noticed that there are dimethylated xylidines and cumidines which readily combine with methyl iodide. The dimethylated bases existing in the less volatile fractions of commercial dimethylaniline, all form quartary compounds without difficulty, and must therefore correspond to xylidines and cumidines, which differ from those derived from trimethylated phenylammonium iodide.

In what relation stands the cumidine above described to the cumidines already known? Of the several purely methylic cumidines which are possible, two only are somewhat accurately known; these are the two bases, which are derived, the one from so-called pseudocumol (obtained by treating xylilic bromide and methylic iodide with sodium), the other from mesitilol. The former cumidine is a solid, fusing at 62°, and need not therefore be further considered here. Most probably the cumidine above described will prove identical with the primary monamine corresponding to mesitilol. Unfortunately, mesitylamine has been hitherto so little studied, that even its boiling-point is not known. I hope next winter to examine more minutely this group of compounds.

In conclusion, I have great pleasure in expressing my best thanks to Mr. E. Mylius, assistant in the Berlin Laboratory, for the zeal and care with which he has furthered the progress of these researches.

NEW METHOD FOR PRODUCING AMIDES AND NITRILES.*

By E. A. LETTS, Berlin University Laboratory.

Some time since Professor Hofmann† has shown that phenyl mustard-oil, when acted on with acetic acid under pressure, is converted into phenyl-diacetamide, carbonic anhydride and sulphuretted hydrogen being separated—

$$\left.\begin{matrix}CS\\C_6H_5\end{matrix}\right\}N + 2(C_2H_3O\text{-}OH) = \left.\begin{matrix}C_6H_5\\(C_2H_3O)_2\end{matrix}\right\}N + CO_2 + H_2S.$$

Bearing this reaction in mind, the question arose as to

* A Paper read before the Royal Society.
† Hofmann, *Beriche. d. Deutch. Chem. Gessell.*, 1870.

how the metallic sulphocyanates would behave under similar circumstances; at Professor Hofmann's suggestion I have submitted this question to an experimental investigation.

Action of Acetic Acid on Potassium Sulphocyanate.

Supposing the potassium salt of sulphocyanic acid to undergo a change analogous to that observed with the phenyl mustard-oil, it was to be expected that 1 molecule of this body would react with 3 molecules of acetic acid to produce 1 molecule of potassium acetate and 1 molecule of diacetamide, carbonic anhydride and sulphuretted hydrogen being evolved—

$$KCNS+3(C_2H_3O\text{-}OH)=$$
$$=C_2H_3O\text{-}OK,(C_2H_3O)_2HN+CO_2+H_2S.$$

The reaction, however, takes a different course.

In my first experiments the acetic acid was allowed to react on the sulphocyanate under pressure; but it soon became evident that this was unnecessary, simple digestion of the two bodies in a flask provided with an upright condenser being amply sufficient.

The powdered salt dissolves readily in the boiling acid, and an immediate and copious disengagement of gases ensues, in which carbonic anhydride and sulphuretted hydrogen may be readily recognised. Considerable time, however, elapses before the sulphocyanide is completely decomposed, some three or four days being required for a mixture of 100 grms. potassium sulphocyanate and 180 grms. acetic acid. At the end of this time the products of the reaction were submitted to distillation and commenced boiling at 170°-180°; the thermometer, however, rose rapidly to 216°; and between this temperature and 220° the distillate solidified in the receiver to a radiating crystalline mass, which analysis showed to be pure *acetamide*‡. Above 220° nothing further distilled, the residue in the retort consisting wholly of potassium acetamate. In what manner had acetamide been formed, instead of diacetamide expected in the reaction? It appeared not unlikely that the acetic acid employed contained some water, and that the diacetamide produced in the first instance was thus converted into the mono-compound—

$$\left.\begin{matrix}(C_2H_3O)_2\\ H\end{matrix}\right\}N+H_2O=C_2H_3O\text{-}OH+\left.\begin{matrix}C_2H_3O\\ H_2\end{matrix}\right\}N.$$

To remove any water which might possibly have been present, the acetic acid was treated with phosphoric anhydride, and the experiment with the sulphocyanate repeated; but even now acetamide was exclusively obtained.

On submitting, however, the gases evolved during the reaction to a closer examination, the formation of acetamide became at once intelligible. It was found that a large proportion of these gases consisted of carbonic oxysulphide (COS). To prove the presence of this compound, it was only necessary to pass the evolved gases through a bottle containing a slightly acid solution of lead, by which the sulphuretted hydrogen was retained: thus purified, they produced no further precipitate when passed through a second bottle containing the same solution; but precipitation at once took place if this solution were rendered alkaline by soda or ammonia. This is the characteristic behaviour of carbon oxysulphide, which was further identified by its odour, great density, and inflammability.

The principal reaction that takes place when acetic acid is treated with potassium sulphocyanate is accordingly as follows:—

$$(1)\ KCNS+C_2H_3O\text{-}OH=C_2H_3O\text{-}OK+HCNS,$$
$$(2)\ HCNS+C_2H_3O\text{-}OH=C_2H_3O\text{-}N\text{-}H_2+COS.$$

‡ The liquid products passing over before 216° yield considerable quantities of the amide on fractionation; this remark applies to the other experiments with *the fatty acids* to be presently described.

The sulphuretted hydrogen and carbonic anhydride, produced simultaneously with the carbonic oxysulphide, are the complements of a second reaction; the principal product of which I have not the least doubt is *acetonitrile*.

$$C_2H_3O\text{-}N\text{-}H_2+COS=\overset{III}{C_2H_3}\overset{V}{N}+H_2S+CO_2.$$

I must remark, however, that I have not actually proved the formation of this body by experiment. My investigations in the acetic series were completed before this phase of the reaction was thoroughly understood, and thus, probably owing to its low boiling-point (77°), the acetontrile had been carried off with the stream of disengaged gases, and had escaped detection. I have not repeated the experiment, because in other series it has been easy to demonstrate the formation of the nitrile.

Action of Isobutyric Acid on Potassium Sulphocyanate.

If potassium sulphocyanate be heated with isobutyric acid (which may now be readily obtained in a state of purity by oxidation of the isobutyric alcohol separated from fusel oil), the salt melts under the acid to an oily layer, from the surface of which bubbles of gas are plentifully disengaged, consisting, as in the preceding case, of carbonic oxysulphide, carbonic anhydride, and sulphuretted hydrogen. In consequence of higher boiling-point of isobutyric acid (154°), the reaction proceeds more rapidly than with acetic acid. If the mixture be submitted to distillation when all disengagement of gas has ceased, it begins boiling a few degrees above 100°, the thermometer rapidly rising to 216°; during this time an aromatic liquid passes over, possessing the odour of butyric acid.

Between 216° and 220° the thermometer remains tolerably constant, the distillate solidifying in the receiver to a white crystalline mass. On fractionating the liquid portion passing over before 200°, no product can be obtained showing a constant boiling-point; but on treating it with a solution of caustic soda, an oily aromatic liquid of characteristic odour floats on the surface, which, separated by a large funnel and dried over calcium chloride, boils constantly between 107° and 108°. Its composition and reactions characterise this substance as isobutyronitrile.

$$C_4H_7N=\begin{matrix}H\text{-}C\text{-}(CH_3)_2\\ |\\ CN\end{matrix}$$

		Theory.		Experiment.
C_4	.. .. ..	48	69·56	68·93
H_7	.. ..	7	10·14	10·53
N	.. .. ..	14	20·30	——
		69·	100·00	

Boiled for some time with an alkali, this nitrile is converted into isobutyric acid and ammonia. The complementary products attending the production of this body are carbonic anhydride and sulphuretted hydrogen, whose copious evolution have already been mentioned.

$$HCNS+C_4H_7O\text{-}OH=C_4H_7N+CO_2+H_2S.$$

Isobutyronitrile has been prepared by Merkownikoff.* He obtains it by treating isopropyl iodide with cyanide of potassium, but probably not in a state of purity, as he gives 80° as its boiling-point; whereas 107° to 108°, the number obtained by myself, approaches more closely that observed for the normal butyronitrile (114°). The crystalline substance before described as passing over between 216° and 220° is the amide of isobutyric acid—

$$C_4H_9NO=\left.\begin{matrix}C_4H_7O\\ H_2\end{matrix}\right\}N=\begin{matrix}H\text{-}C=(CH_3)_2\\ |\\ O=C\text{-}N=H_2.\end{matrix}$$

* Merkownikoff, *Jahresb.*, xviii., 318.

The analysis gave—

	Theory.		Experiment.
C_4	48	55·17	54·86
H_9	9	10·35	10·45
N	14	16·09	——
O	16	18·39	
	87	100·00	

Isobutyramide forms a white crystalline mass of pleasant aromatic odour; it fuses between 100° and 102°, and when heated somewhat above this temperature, but far short of its boiling-point, sublimes in beautiful iridescent laminæ. It boils between 216° and 220°, and distils without the slightest decomposition. It dissolves readily in water and alcohol, and slightly in ether. Isobutyramide is the principal product of the action of isobutyric acid on potassium sulphocyanate.

$$HCNS + C_4H_7O\text{-}OH = \left.\begin{matrix}C_4H_7O\\H_2\end{matrix}\right\} N + COS.$$

200 grms. of the acid yielded 60 grms. pure amide.

Isobutyramide—

$$\begin{matrix}H\text{-}C\text{-}(CH_3)_2\\ |\\ O=C\text{-}N=H_2,\end{matrix}$$

distinguishes itself from the normal amide—

$$\begin{matrix}H_2=C\text{-}CH_2\text{-}CH_3\\ |\\ O=C\text{-}N=H_2,\end{matrix}$$

by its lower melting-point. The iso-compound fuses between 100° and 102°, whereas the normal butyramide melts at 115°. The boiling-point is much the same for both.†

Action of Valeric Acid on Potassium Sulphocyanate.

In this instance, too, the reaction proceeds according to the two equations—

$$HCNS + C_5H_9O\text{-}OH = C_5H_9N + CO_2 + H_2S,$$
$$HCNS + C_5H_9O\text{-}OH = \left.\begin{matrix}C_5H_9O\\H_2\end{matrix}\right\} N + COS.$$

The separation and purification of the valeronitrile and valeramide is similar in all respects to that employed for the corresponding compounds in the butyric series. Valeronitrile, already investigated by other chemists, boils between 125° and 128°. By treatment with fumic nitric acid, it is converted into a crystalline substance (perhaps $C_5H_8(NO_2)N$), which I have not as yet been able to examine further.

Valeramide closely resembles the isobutyramide. It is a white crystalline body of pleasant aromatic odour, recalling that of the valerian root: it is soluble in water, alcohol, and ether; in the last-mentioned liquid much more so than the isobutyramide. From hot water it crystallises in large right-angled but very thin plates. Valeramide fuses between 125° and 128°, and sublimes in the same manner as isobutyramide below its boiling-point, which lies between 230° and 232°. It distils without decomposition.

Action of Benzoic Acid on Potassium Sulphocyanate.

The aromatic acids, $C_nH_{(2n-8)}O$, series react in an analogous manner with potassium sulphocyanate, with the difference, however, that here nearly exclusively the nitrile is formed. The production of amide is so insignificant as to be scarcely recognisable. The reaction with *benzoic acid* takes place with particular facility according to the equation—

$$HCNS + C_7H_5O\text{-}OH = C_7H_5N + CO_2 + H_2S.$$

2 mols. benzoic acid and 1 mol. potassium sulphocyanate (both in a perfectly dry condition) are placed in a retort, to the mouth of which a long wide tube is attached to serve as condenser. The apparatus thus arranged is placed vertically, and heated either in a paraffin-bath or over the naked flame. Both bodies melt, forming two layers, of which the benzoic acid is the lower. At 190° the reaction commences, carbonic anhydride and sulphuretted hydrogen being evolved. At a higher temperature the mixture enters into ebullition, and in about half an hour swells to a solid mass. The retort is now reversed, and the contents strongly heated; they melt, boil, and yield a semi-solid distillate. The distillation is carried on as far as possible without charring the residue, which consists of potassium benzoate, from which half the benzoic acid employed may be covered. By addition of ammonia to the semi-solid distillate the acid is retained, whilst the nitrile distils with the water, from which it is afterwards separated, dried, and re-distilled. A roughly carried out experiment yielded 80 per cent of the theoretical quantity of nitrile in a perfectly pure condition; the loss owing to secondary reactions is amply compensated by the ease and rapidity of the operation.

Action of Cuminic Acid on Potassium Sulphocyanate.

An experiment with cuminic acid yielded very satisfactory results: cumonitrile was obtained in about the same proportions as the benzonitrile. The temperature at which reaction commenced was here about 211°; the nitrile was purified as in the preceding case.

Finally, an experiment was made with cinnamic acid; but although sulphuretted hydrogen was evolved, and the reaction appeared to proceed quite as in the foregoing cases, no tubuli was obtained in the liquid distillate. The cinnamic acid seemed to be decomposed into carbonic anhydride and cinnamol before becoming acted upon by the sulphocyanic acid.

The ease with which so many nitriles and amides are obtained, both in the aromatic and fatty series, induces me to hope that the new method may be of use in many cases, and perhaps by its application to other series give rise to bodies hitherto uninvestigated.

The tediousness of preparing the acid chloride, and subsequent treatment with ammonia (for the amide) or phosphoric anhydride (for the nitrile) in the ordinary method for producing these nitrogen compounds, is here replaced by simple digestion of the acid with sulphocyanate of potassium, bodies generally readily procurable.

† It is remarkable that acetamide, butyramide, and isobutyramide all have the same boiling-point, namely, 216° to 220°.

MINERALOGY.

The sixth and concluding lecture of the course to working men, by Mr. W. W. Smyth, F.R.S., delivered on Monday evening, December 16, was on "The Ores of Iron and their Various Modes of Occurrence."

The lecturer commenced by drawing attention to the vast importance of the iron trade to the well-being of this country, the yield of ore during last year being no less than 17,000,000 tons. The percentage composition of some of the principal iron ores was given as under:—Magnetic iron ore—Fe 72·4, O 27·6; specular iron ore, or red peroxide of iron—Fe 70, O 30; brown iron ore, or hydrated oxide of iron—Fe 60, O 26, H_2O 14; sparry iron ore, or carbonate of iron—FeO 62, CO_2 38.

Magnetic iron ore, or "magnetite," received its name in early times from its magnetic properties. These the lecturer illustrated by means of a magnetic needle, a mass of the ore influencing the needle at a great distance. The magnetism of the ore was shown to be polar, the same side which repelled one end of the needle attracting the other, and *vice versa* with the other side. It crystallises in the cubical system, the octahedron and rhombic dodecahedron being common forms. It occurs in Sweden, Norway, the Ural Mountains, &c., and on a very much smaller scale in England. In the south-east corner of

Dartmoor, a band of this kind of ore deranges a compass as it is carried past its vicinity, and sailors say that there is a place in Cardigan Bay, where on passing a reef of rocks the needle is influenced, and set oscillating. A large mass of this deposit in the south-east extremity of the Island of Elba has a similar effect; in Sweden, too, deposits are discovered by means of this property. Meteorites frequently contain a percentage of iron greater than magnetite, associated with nickel and chrysolite in some cases, but the rarity of their occurrence precludes them from being classed as iron ores, by which term we understand a mineral containing iron in sufficient quantity as to be economically and advantageously extracted.

Specular iron ore occurs in this country on a far larger scale than the preceding variety, the greater proportion of which (either as ore or metal) we have to import from Sweden. The crystalline form of this ore belongs to the hexagonal system, the crystals being, as a rule, tabular. It occurs usually of a bluish black colour, sometimes a brownish red, at others with an iridescent film; while large crystals (as some of these from Brazil) occur occasionally with a lustre so great as to have obtained for it the name of specular or looking-glass ore. But the bulk of the ore, as found in this country has a rounded or mammilated form, and hence is known as "kidney ore," while from its deep rich red colour in some varieties, it is known as hæmatite, or blood-stone. These ores may be readily distinguished from the magnetic by their giving in all cases a red powder when scratched or powdered, whereas the magnetic always give a black powder. They occur especially in the northern districts of England, the districts of Furness and West Cumberland being notably rich. The produce of the mines in those districts for last year was—Furness, 931,000 tons; Cleator, 976,874 tons; Hodbarrow, 207,146 tons; making a total of 2,115,000 tons, the value of which as ore being, in round numbers, £2,500,000. It likewise occurs in the Island of Elba (notably round Rio, where many of the rocks quite spangle in the sun with scales of this ore), Bilbao in Spain, Saxony, and North America.

The brown ore, or hydrated oxide, is distinguished from the other varieties by giving a brown powder, and this whatever its external appearance. The quantity of water varies considerably; it is usually from 10 to 15 per cent. It is driven off by a process of calcination—in other words the ore is roasted. It occurs chiefly in our western mining districts, South Wales, and the Forest of Dean. In some cases it occurs in irregular cavities in the strata, with the appearance of having been deposited in them much in the manner of stalactites. The stratified deposits of this ore, occurring in strata belonging to the secondary formation in the midland counties, have only lately had much attention devoted to them, but they will probably come more and more into play as the deposits of superior ore fall away. The town of Middlesborough, and those in its neighbourhood, owe their rapid rise and development entirely to valuable deposits of these ores—Cleveland ores—discovered a few years ago in the neighbourhood.

Spathose, or sparry iron ore, known as "white iron" ore by the miners on accout of its light colour, is generally found mixed with carbonates of lime, magnesia, &c. Some rhombohedral crystals are found of a pale yellow colour, though the general colour of it varies considerably. It occurs in marked abundance in England, and also in Germany, Austria (at Styria it has been worked for many hundred years), and other places. In England its principal mode of occurrence is in the form of nodules, mixed with much clay, whence the term "clay ironstone." It is found in beds or layers, interstratified with the various strata of the coal measures. The nodules contain in some cases as much as 30 per cent of the metal; when split they frequently present patterns of crystallised substances, which have been introduced into the mass by infiltration, and deposited in the cracks which have been formed in the mass by shrinkage. "Black band" iron ore is a variety of argillaceous ore which has of late years been employed in Scotland; it owes its colour to associated carbonaceous matters, which prove of great use in calcination by diminishing the supply of extra fuel required.

There is one more mineral which is important as yielding iron, but which has only lately been utilised for the purpose, being formerly thrown away as worthless. This is iron pyrites, a compound of iron and sulphur. When, in 1840, the King of Sicily partially prohibited the export of sulphur from that island, the attention of chemists was directed towards this mineral, with the hope of extracting that material from it. Even after means were found for doing this, the remainder still remained unemployed till at length means were discovered which enabled us to obtain not merely the iron, but also to extract a small proportion of copper, and also a minute quantity of silver which occurs in the mineral. Large quantities are obtained from Ireland and from Spain and Portugal.

UNUSUAL AMOUNT OF AMMONIA IN A SO-CALLED SPA WATER.

By CHARLES A. CAMERON, M.D.,
Professor of Hygiene, Royal College of Surgeons, Ireland; Analyst to the City and County of Dublin, &c.

A spring situated at Portobello, a suburb of Dublin, has been for many years in some repute as a sulphur spa, and wonderful cures have been attributed to the use of its waters. I have recently analysed it on behalf of the local authorities, and its composition is so peculiar that I think it worth while to publish it. An imperial gallon contains—Solid matters (chiefly calcic carbonate), 24·236 grains; chlorine, 1·11 grains; organic nitrogen, 0·0035 grain; organic carbon, 1·26 grains; ammonia, 0·562 grain; hydric sulphide (all, except a trace, combined with ammonia), 0·406 grain; nitrites and nitrates, faint traces. Five gallons, evaporated nearly to dryness, gave a remarkable jelly-like residue. The water is clear, of a very light yellowish green colour, and has an odour of sulphuretted hydrogen, which passes away after an hour or two. Only minute quantities of iron and silica are present, and there are no sulphides, except the ammonic sulphide.

There is nothing in the water to account for its reputed medicinal qualities; but the enormous amount of ammonia which it contains, when compared with the minute quantity of albumenoid nitrogen, is very remarkable.

ON SOIL ANALYSES AND THEIR UTILITY.*

By EUG. W. HILGARD, State Geologist of Mississippi.

In the *American Journal of Science* for September, 1861, Prof. S. W. Johnson published a criticism on the "Soil-Analyses of the Geological Surveys of Kentucky and Arkansas," whose strictures, to a great extent eminently just, appear to have so impressed the scientific public in this country, that few if any soil-analyses have since then been made in connection with any state or national survey, excepting that of the State of Mississippi, where the work already begun was continued, either by myself, or under my charge, or recommendation, by others. Holding myself responsible for this departure from the generally adopted views, I propose in the present paper to discuss specially Prof. Johnson's objections, and to give my reasons for persisting in a course of research that has, more than once, secured for myself and my co-labourers

* Read at the Dubuque Meeting of the Am. Assoc. Adv. Sci, August, 1872.

the compassionate sympathy of true believers. While I consider the work far from being as complete as it should be, and for that as well as other reasons its publication in detail may be delayed for some time, yet I think what can now be said of sufficient importance to be brought before this meeting.

I propose, in this discussion, to maintain the mainly practical standpoint assumed by Prof. Johnson himself. I shall therefore leave out of consideration the performance of such exhaustive investigations of *all* the physical and chemical properties of the soil, as have been made in some cases, for special purposes, *e.g.*, by Prof. Mallet, on some of the cotton soils of Alabama. If the investigation of each soil, to possess practical importance, requires from three to six months labour, we may as well, for practical purposes, consider such researches out of the question for the present. We want something analogous to the metallurgical assay of minerals, as distinguished from their complete ultimate analysis. So far, therefore, as the agricultural qualities of a soil may be inferred and approximately estimated by an experienced eye, I would relieve the chemist from the exact numerical determination, *e.g.*, of the power of absorbing heat from the sun, the specific heat, the "water-holding" power, the capillary coefficients, &c. However necessary for theoretical investigations, I hold that, for practical purposes, these laborious determinations may in most cases be dispensed with; since from what has already been done, or what can be done with a few typical soils, we may infer the comparative magnitude of these coefficients with a sufficient degree of approximation.

The amount of labour bestowed on each soil by Dr. Peter, as reported in the Kentucky and Arkansas surveys, approaches very closely the limit beyond which the *immediate* advantages to be derived from such knowledge of soils as analysis may impart, would seem, to many, disproportioned to the expenditure involved. How very modest we are, truly, when a purely scientific object is involved, whose immediate practical apptication is not obvious at a glance! In what other branch of technical science would it be thought admissible to proceed without obtaining such knowledge of the prime materials as chemistry may afford, even if no immediate application of this knowledge be foreseen? Our public treasuries are constantly drawn upon for hundreds of thousands of dollars, in behalf of objects of at least questionable usefulness. Yet Prof. Johnson seems to have thoroughly satisfied our state geologists that they are not justfied in giving the virgin soils of their respective States the benefit of such light as chemistry may even now confessedly afford; apart from the important general inferences which may fairly be expected to be drawn hereafter from the history of their cultivation. How are we to advance in our knowledge of soils if we abandon as hopeless the determination of their chemical character? Are the proofs that have been brought against the utility of soil analyses really of such a character as to justify so grave an omission? an omission, too, which in many cases cannot hereafter be supplied. Even in the comparatively youthful State of Mississippi, I have found difficulty in obtaining reliable specimens of some soils, whose great productiveness had led to their cultivation by the earliest settlers, over the entire area of their occurrence.

I question the propriety of this omission, and the justice of the *testimonium paupertatis* thus inflicted upon agricultural and analytical chemistry.

To define my position, I premise that—

1. I fully agree with Prof. Johnson as to the comparative uselessness of a single analysis giving the percentages of soil ingredients found, in ordinary cases. It is only when such analysis demonstrates the great abundance, or very great deficiency, of one or several primarily important ingredients, that, by itself, it conveys information of considerable practical importance. Note that such cases are not altogether infrequent, even in virgin soils.

2. I agree that an "average soil" is *a non ens*, except as referred, comparatively, to a particular set of soils closely related in their origin.

3. Also, that the claim of being able to detect the minute differences caused by cropping without return to the soil, is precarious, and perhaps beyond the power of our present analytical resources.

4. I further admit that, ordinarily, the analysis of soils long cultivated, and treated with manures, can give but little and very partial information as to the condition and composition of the soil; from the great difficulty, if not impossibility, of obtaining fair representative specimens.

5. Furthermore, that to designate soils by the names of the Cretaceous, Carboniferous, or Silurian strata they may happen to overlie, is very loose practice; since in most cases they are derived from Quaternary deposits, which may or may not have been influenced in their composition by the subjacent rocks.

On the contrary, I demur, in the first place, to the broad assertion that "it is practically impossible to obtain average specimens of the soil," as inapplicable to a very large class, especially of virgin soils, covering large areas with a uniformity of character corresponding to that of subjacent formations, from which they have been directly derived, by substantially identical and uniform, or uniformly variable processes.

The importance of this exception is not, it is true, very obvious in the stony fields of New England (such as discouraged Prof. Johnson in his vacation trip to Northern New York), or in fact, in any district where a great variety of formations has directly contributed toward forming the soil, and "chunks" of undecomposed minerals are diffused through it. In such cases, the analysis of the rock which has predominantly contributed to the mass of the soil proper, would be a more correct index of the prevalent characteristics of the latter than if itself were taken in hand. And from such analyses we could at least deduce what ingredients, and in what form, it would certainly be useless to add to the soil.

But when we come to the great plains of the West and South-West, whose soils are consistently derived from wide-spread quaternary deposits, composed of materials almost impalpable, save as regards siliceous sand, or even the rolling uplands of the Gulf States, whose subsoil stratum of "yellow loam" can only be diluted, but not otherwise changed, by the admixture of the underlying drift, leached long ago of everything soluble in carbonated water or available to plants: the objection based upon the supposed impossibility of securing representative specimens, becomes obviously untenable, as I shall hereafter show from the close correspondence in the composition of soils, and especially *sub*-soils, from widely distant portions of the State, derived from the same geological (quaternary) stratum.

A word in regard to the "freaks and accidents" mentioned by Prof. Johnson as liable to make sport of the devoted analyst. Undoubtedly such errors must be ultimately provided against by multiplication of analyses (not necessarily of the same acre, but of other corresponding specimens, in the sense mentioned above); and while questioning the efficiency of a bird or squirrel in vitiating a properly taken sample of soil, I must admit the disastrous consequences which might result if a dog, cow, or horse were similarly concerned. No specimen of "virgin soil" can, of course, be obtained where such animals usually do congregate. But, as a rule, it is not all difficult to avoid such places; while the chance of accidentally hitting upon a sporadic animal deposit in the broad woods or prairies is singularly small, and is notably diminished by the circumstance, that an attentive observer (and none other should take soil specimens) will be able to distinguish such localities for years, by the peculiarity of their vegetation. I will remark, however, that I consider the sampling of a soil with a view to securing a representive specimen, as a matter second in difficulty and delicacy only to the analysis itself; that I rarely have thought it worth while to analyse specimens sent by other than

intelligent persons specially instructed by me; and even then have frequently had to reject them, from their having obviously been taken at an improper locality, *e.g.*, near a footpath, by the side of a fence, on a partially denuded hillside or ravine, in the bed of a run, at the foot of a tree, &c.

The question of *depth* must, in my view, be left to be determined by the circumstances of each case, except in so far as the extreme depth to which tillage may cause the roots of crops to reach, must be within the limits of the samples taken. Of these, *one* should ordinarily represent what, under the usual practice of tillage, becomes the arable soil; another the subsoil not usually broken into; a third will in most cases be useful to show what materials would be reached were the land to be underdrained. As a rule, I have taken no specimens of soil to a less depth than six inches, and as much deeper as uniformity of colour reached—for obvious reasons. But in special cases, when important differences were suggested by the aspect of the soil and subsoil, they have been separately examined, at whatever depth the change of colour might occur.

With soils of the character referred to, samples selected and taken with due care, and strict attention to thorough intermixture, both in the field and subsequently in the laboratory, I am unable to see why even two grammes may not correctly represent the characteristics of a 1000 acre tract. Not that every point of that tract would be likely to give the same percentage result, perhaps, especially as regards the surface soil, which might in places be more clayey or more sandy than the sample analysed. Still, the relative proportions of the soil ingredients, and their degree of availability, would remain substantially the same; the wider range and readier penetration of roots in sandier soils, making up, within certain limits, for the smaller percentage of available ingredients in a given bulk, as compared with more clayey ones.

From the fact that the atmospheric surface water must, in its course, inevitably have a tendency to bring about such inequalities, by carrying forward the finer particles of the soil in larger proportion than the coarser ones, as well as from the greater influence of vegetation, we shall, in the series of analyses, made a postulate by Prof. Johnson, expect to find a closer agreement between those of subsoils than those of surface soils. Such I find to be very decidedly the case; so much so that I habitually look to the former as the most reliable index of a soil's distinctive character. To this there can be no legitimate objection, when, as in all the upland soils now under consideration, the surface soil is directly derived from the subsoil, and its depth is less than thorough culture would give to the arable soil.

As regards the analysis itself, I premise that I have always found even the most "chemically pure" reagents sold by dealers quite inapplicable to the purpose of soil analysis. From first to last, I have prepared or purified these myself; and, as regards the acids, especially hydrochloric, I have found it necessary to reject, as a rule, even the purest, after keeping it for a few weeks in a glass bottle. The same is true, and perhaps in an aggravated degree, of aqua ammoniæ. The severe ordeal of slow evaporation on a bright platinum foil will rarely be passed by ammonia a fortnight old; and still less frequently by hydrosulphide of ammonium.

Armed with these, and a multitude of other precautions, usual and unusual, to secure the utmost possible accuracy; always treating the soil with the same large excess of acid of uniform strength, and precipitating all corresponding precipitates as much as possible from the same volume of liquid; using none but the best Bohemian glass, and platinum vessels, and filters specially extracted—operating, in short, as uniformly as the nature of the materials would permit: I confess I felt considerable confidence in the correctness of my results, until the experiments made in Bunsen's laboratory, on the solubility of glass vessels, gave rise to unpleasant doubts. On consideration, however, I found that the (sensibly constant) error so introduced would not, when allowed for, amount to more than the differences between two analyses of one and the same material, or vitiate in any serious degree the conclusions arrived at. Nevertheless, I shall hereafter, to the utmost possible extent, carry on all operations liable to introduce errors on this score, in platinum and porcelain vessels. as advised by Bunsen.

As regards Dr. Peter's failure to determine the amounts of soluble silex, nitric acid, ammonia, chlorine, and the degree of oxidation of the iron, I agree that the former is desirable, not only because, whether "essential" or not, some plants do habitually absorb it in very large quantities, and it might be best to let them have it; but also because it is a desirable index of the degree of decomposition which the soil silicates have undergone. I have therefore made this determination regularly, by boiling with solution of sodium carbonate. In a series of these determinations, an unmistakable relation between the soluble silex and the amount of lime in the soil becomes manifest; as might, indeed, have been foreseen.

As regards nitric acid, the consideration suggested by Prof. Johnson himself, viz., that its quantity must be exceedingly variable, within short periods, in one and the same soil, seems to me a sufficient dispensation from the laborious determination.

The same holds good, in a measure, for ammonia. Its quantity varies continually in the soil, as it does in the atmosphere; its chief absorbers in the soil are "humus" and clay. Where these prevail largely, ammonia can scarcely be deficient as a nutritive ingredient to an injurious extent; albeit, more might doubtless be beneficially added. Moreover, the characteristic effects of ammonia on vegetation are sufficiently obvious (in "running to weed") to render its determination in virgin soils, laborious and even uncertain as it is, a matter of comparatively little practical consequence, however great might be its theoretical interest.

As for the determination of the degree of oxidation of iron, I confess I fail to see its practical bearing. When ferric oxide is present, plants surely can have no difficulty in reducing the modicum they need to a soluble condition. When ferrous oxide exists to any great extent, it indicates a want of drainage, and manifests itself both in the colour of the soil and in the poisonous effect on vegetation. But farmers surely do not need the aid of chemical analysis to tell them that their soil needs drainage and aëration! A determination made to-day would be of no value to-morrow, if the soil had been ploughed in the interval.

Finally, Dr. Peter *does* determine *chlorine* in the treatment of soils with carbonated water, though it is not put down in the general analysis. However, the soluble chlorides, like the nitrates, are so constantly liable to variation, and, as experience shows, so little likely to be deficient in the soil, that its omission would not be a serious practical objection.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 10th, 1872.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*Observations of the Meteoric Shower of November 27th, 1872.*"

1. By E. W. Binney, F.R.S., F.G.S.—On the 27th November last, at Douglas, in the Isle of Man, my

attention was called by an inmate of my house to numerous meteors in the sky. On going out of doors about 7.45 p.m., they were seen radiating from a point in Andromeda and falling in all directions towards the horizon, some not proceeding far down before they disappeared, whilst others travelled to a much greater distance. The sky was perfectly clear for three hours, during which time I observed them, and they appeared in all directions to be equally numerous except during the last hour. Some were as large as a star of the first magnitude and others were only just perceptible. Nearly all of them appeared to leave tails in their course, which were generally straight, but some of them were curled. In colour most of them were white or yellowish white, but some of the larger ones were of a reddish tinge. At about 7.45 p.m. six were noticed at one time. At 8.45, on looking at about a quarter of the space of the heavens, towards the west, I counted during a minute 21, 11, 24, and 12 respectively. This would give an average of 17 per minute; assuming that the other three portions of the heavens afforded as many, and to me the meteors appeared to be about equally dispersed, so there would be probably about 68 per minute during the two first hours I observed them. At eleven o'clock they were still falling, but not so numerously. The early part of the evening was rainy, but it cleared up shortly before seven, and I am informed that meteors were then observed.

On the 3rd December inst., at 8.45 p.m., there was visible an aurora in the form of a beautiful arch of a yellowish white colour, extending from east to west, and reaching up to the lower parts of *Ursa Major*. A slight trace of streamers was seen on the top of the arch.

2. By Joseph Baxendell, F.R.A.S.—The early part of the evening of the 27th of November was cloudy, and the meteors were not seen till about 10 minutes to 7, when a partial clearing occurred. It soon became evident that they belonged to a distinct meteoric stream, and my attention was therefore chiefly directed to the determination of the position of the radiant point. The observations were, however, frequently interrupted by clouds, and at no time was the sky entirely cloudless. The intervals of observation and the number of meteors whose tracks were observed with sufficient precision to be of use in the determination of the position of the point of divergence were as follows:—

h. m.		h. m.		Number of Meteors.
6 53	to	7 9	G. M. Time........	65
7 21		7 51	....	54
8 1		8 15	....	80
8 31		8 34	....	9
8 49		9 2	....	31
11 21		11 27	....	7
11 33		11 54	....	15
12 7		12 19	....	10

The total number was 271, and of these 266 had the points of intersection of their paths in an elliptical area of 12 degrees long and 8 or 9 degrees broad, the centre of which was in right ascension 22½ degrees, and north declination 44½ degrees, near the small star Chi Andromedæ. Three of the remaining five had their radiant point in the constellation Cassiopeia.

The average brightness of the meteors was equal to that of a star between the 3rd and 4th magnitudes; many, however, were equal to stars of the 1st magnitude, and several of the finest exceeded the planets Jupiter and Venus when in their positions of maximum brilliancy. The colour for the most part was white; in many, however, it was yellow or orange, and in several of the brightest it was at first white and then a deep red immediately before extinction.

Most of the brighter meteors left luminous trains, but these seldom remained visible for more than a few seconds.

The apparent velocity of movement was decidedly less than that of the 13th of November meteors.

The paths of many of the meteors were more or less curved, and many of them formed curves of double curvature.

It was observed that the radiant point appeared to move to the eastward during the progress of the shower, so that the mean position, from the observations made up to 8h. 34m., was about 3 degrees to the west of the position derived from the observations made afterwards.

The mean position of the radiant point, as given above, shows that the course of the stream coincides almost exactly with the orbit of Biela's comet.

3. By Alfred Brothers, F.R.A.S.—The sky at Wilmslow appears to have been less clouded than at Cheetham Hill, and I may therefore have had a better view of the display than Mr. Baxendell. From about 5.50 to 8.30 there was very little cloud, and during that the meteors were falling very nearly at the same rate. There was no difficulty in determining the radiant point—γ Andromedæ being about the centre.

Probably few meteor showers have ever been seen more favourably for determining their radiancy than this one. The result of careful counting by myself and Mr. Wilde was that from 1800 to 2000 per hour were visible to the naked eye. The N.W. horizon was distinctly illuminated about 8 o'clock by auroral light, and the whole sky was more or less luminous during the whole time.

Mr. W. Boyd Dawkins, F.R.S., brought before the notice of the Society some remarkable forms of stalagmites which he had obtained from some caves near Tenby. In one cave the calcareous deposit had taken the form of small mushrooms standing close together with a stem not much thicker than a hair, that covered every part of the surface, and in some places had their tops of a dull red colour, and in others of a snow white. In a second every pool was lined with most beautiful crystals of a dog-tooth spar, while from the roof there descended slender stalactitic pillars, some snow white and others of a deep red, and most of the thickness of a straw. They stood almost as closely together as the stems of wheat in a wheat-field. In a few pools where the drip caused constant agitation of the water, pea-like rounded concretions of carbonate of lime were formed, some of which, polished by friction, were almost as lustrous as pearls, and might fairly be termed "cave-pearls."

"*On the date of the Conquest of South Lancashire by the English*," by W. Boyd Dawkins, M.A., F.R.S.

"*On some Human Bones found at Buttington, Montgomeryshire*," by W. Boyd Dawkins, F.R.S.

"*On the Electrical Properties of Clouds and the Phenomena of Thunder Storms*," by Professor Osborne Reynolds, M.A.

The object of this paper is to point out the three following propositions respecting the behaviour of clouds under conditions of electrical induction, and to suggest an explanation of thunder storms based on these propositions and on the assumption that the *sun is in the condition of a body charged with negative electricity*: an assumption which I have already made in order to explain the Solar Corona, Comets' Tails, and Terrestrial Magnetism.

1. A cloud floating in *dry* air forms an insulated electrical conductor.

2. When such a cloud is *first* formed it will not be charged with electricity, but will be ready to receive a charge from any excited body to which it is near enough.

3. When a cloud charged with electricity is *diminished* by evaporation, the tension of its charge will increase until it finds relief.

I do not imagine that the truth of these propositions will be questioned, but rather that they will be treated as self evident. However, as a matter of interest, I have made some experiments to prove their truth, in which I have been more or less successful.

Experiment 1 was to show that a cloud in dry air acts

the part of an insulated conductor. The steam from a vessel of hot water was allowed to rise past a conductor, the apparatus being in front of a large fire, so that the air was very dry. When the conductor was charged the column of vapour was deflected from the vertical to the conductor both for a positive and negative charge.

Experiment 2 was made with the same object as Experiment 1. A gold leaf electrometer was charged so that the leaves stood open and then a cloud made to pass by the insulated leaves. As the cloud passed they were both attracted. This experiment was attended with considerable difficulty, as the moisture from the steam seemed to get on to the glass shade over the gold leaves and so form a charged conductor between the leaves and cloud. The cloud was first formed by a jet of steam from a a pipe, then by the vapour from a vessel of boiling water, and lastly, by a smoke ring or rather a steam ring. By this latter method an *insulated* cloud was formed, which, as it passed, was attracted by the charged leaf.

Of the two latter propositions I have not been able to obtain any experimental proof. I made an attempt, but failed, through the bursting of the vessel in which the cloud was to be formed. I hope, however, shortly to be able to renew the attempt, and in the meantime I will take it for granted that these propositions are true. Faraday maintained that evaporation was not attended by electrical separation unless the vapour was driven against some solid, when the friction of the particles of water gave rise to electricity. So that unless there were some free electricity in the steam or vapour before it was condensed none could be produced by the condensation, and hence the cloud when formed would be uncharged.

In the same way with regard to evaporation, unless, as is very improbable, the steam into which the water is turned retains the electricity which was previously In the condensed vapour; the electricity from that part of the cloud which evaporates must be left to increase the tension of the remainder. So that, as a charged cloud is diminished by evaporation, the tension of the charge will increase, although the charge remains the same.

I will now point out what I think to be the bearing which these propositions have on the explanation of thunder storms. In doing this, I am met with a great difficulty, namely, ignorance of what actually goes on in a thunder storm. We seem to have no knowledge of any laws relating to these every-day phenomena; in fact we are where Franklin left us—we know that lightning is electricity and that is all.

It is not, I think, decided whether the storm is incidental on the electrical disturbance or *vice versa*, *i.e.*. whether the electricity causes the clouds and storm or is a mere attendant on them. Nor can I ascertain that there is any certain information as to whether, when the discharge is between the earth and the clouds, the clouds are positive and the earth negative, or *vice versa*. Such information as I can get appears to point out the following law: that in the case of a fresh-formed storm, the cloud is negative and the earth positive; whereas, in other cases, the cloud is positive and the earth negative.

Again, thunder storms move without wind or independently of wind; but I am not aware whether any law connecting this motion with the time of day, &c., has ever been observed, though it seems natural that, however complicated by wind and other circumstance, some such law must exist. In this state of ignorance of what the phenomena of thunder really are, it is no good attempting to explain them. What I shall do, therefore, is to show how the inductive action of the *Sun* would necessarily cause certain clouds to be thunder clouds in a manner closely resembling, and for all we know identical with, actual thunder storms.

In doing this I assume that the thunder is only an attendant on the storm and not the cause of it; and that many of the phenomena, such as forked and sheet lightning, are the result of different states of dampness of the air and different densities in the clouds, and really indicate nothing as to the cause of electricity. In the same way, the periodicity of the storms is referred to the periodical recurrence of certain states of dryness in the atmosphere. Thus the fact that there is no thunder in winter is assumed to be owing to the dampness of the air, which allows the electricity to pass from and to the clouds quietly. What I wish to do is to explain the cause of a cloud being at certain times in a different state of electric excitation to the earth and other clouds, and of this difference being sometimes on the positive side and sometimes on the negative, that is to say, why a cloud should sometimes appear to us on the earth to be positively charged, sometimes negatively, and at others not to be charged at all.

The assumed condition of the sun and earth may be represented by two conductors S and E, acting on one another by induction, the sun being negative and the earth positive. The distance between these bodies is so great that the inductive action would not be confined to those parts which are opposed, but would in a greater or less degree extend all over their surfaces, though it would still be greater on that side of E which is opposite to S than on the other side.

The conductor E must be surrounded by an imperfectly insulating medium to represent damp air. The formation of a cloud may then be represented by the introduction of a conductor C near to the surface of E. Such a conductor at first having no charge would attract the positive electricity in E and appear by reference to E to be negatively charged. If it was near enough to E, a spark would at once pass, which would represent a flash of forked lightning. If it were not near enough for this it would obtain a charge through the imperfect insulation of the medium. Such a charge might pass quietly or by the electric brush. When the cloud had obtained a a charge it would not exert any influence on the earth, unless it altered its position. But if the heat of the sun caused part of the cloud to evaporate the remainder would be surcharged and appear positive. Or if C approached E then C would be overcharged, and a part of its electricity would return, and on its return it might cause positive lightning. Thus, suppose that after a cloud had obtained its charge part of it came down suddenly in the form of rain. As the rain came lower its electric tension would increase until it got near enough the ground to relieve itself with a flash of lightning, almost immediately after which the first rain would reach the ground. It has often been noticed that something like this often takes place; it often begins to pour immediately after a flash of lightning, so much so that it seems that the electricity had been holding the rain up, and it was only after the discharge that it could fall. This, however, cannot be the case, for the rain often follows so quickly after the flash that there would not have been time for it to fall from the cloud unless it had started before the discharge took place. If, on the other hand, C receded from E, it would again be in a position to accept more electricity, or would again become negative. In this way, a cloud in forming, or when first formed, would appear negatively charged; soon after it would become neutral, and then if it moved to or from the earth it would appear positively or negatively charged.

If the air was very dry, as it is in the summer, any exchange of electricity between the earth and the cloud would cause forked lightning, in the winter it would take place quietly, by the conduction of the moist atmosphere.

In this way then there would sometimes be positive, sometimes negative lightning; sometimes the discharge would be a forked flash or spark, sometimes a brush or sheet lightning. And if clouds are formed in several layers, as would be represented by another conductor, D, outside C, then, in addition to the phenomena already mentioned, similar phenomena would take place between C and D; and if, in addition to this, we were to assume

that there are other clouds in the neighbourhood, the phenomena might be complicated to any extent.

And if, further, the motion of the sun is taken into account; as the conductor S moves round E the charges in D and E would vary, accordingly as they were more or less between S and E and directly under the induction of S; *i.e.*, the charge in a cloud would appear to change owing to the motion of the sun; thus, a cloud that appeared neutral at mid-day would, if it did not receive or give off any electricity, become charged positively in the evening.

With regard to the independent motion of the clouds, there are several causes which would effect it. For instance, a cloud whether it appeared on the earth to be negatively or positively charged, would always tend to follow the sun, though it is possible this tendency might be very slight. Again, one cloud would attract or repel another, according as they were charged with the opposite or the same electricities; and in the same way a cloud would be attracted or repelled by a hill, according to the nature of their respectfve charges.

Such, then, would be some of the more apparent phenomena under the assumed conditions. So far as I can see, they agree well with the general appearance of what actually takes place, but, as I have previously said, the laws relating to thunder storms are not sufficiently known to warrant me in doing more than suggesting this as a probable explanation.

In these remarks I have said nothing whatever about what is called atmospheric electricity, or the apparent increase of positive tension as we proceed away from the surface of the earth. I do not think that this has much to do with thunder storms. If the law is established, it seems to me that it will require some explanation, besides merely that of the solar induction acting through the earth's atmosphere on to the surface of the earth. It would rather imply that the sun acts on some electricity in the higher regions of the earth's atmosphere, and that electricity in these regions acts again on the surface of the earth; but, however this may be, the effect of the assumptions described in this paper would be much the same.

NOTICES OF BOOKS.

Introduction to Inorganic Chemistry. By William George Valentin, F.C.S., Principal Demonstrator of Practical Chemistry in the Royal School of Mines and Science Training Schools, South Kensington.

The student of chemistry must be sometimes at a loss to distinguish for himself the best text-book. Each of the numerous volumes from which he may select has its peculiar feature: and the existence of this plurity of teaching-methods is suggestive of the fecundity of the science, But many text-books unhappily differ in little more than the authors' names; in them there is given description of the orthodox method of preparing hydrogen from water, sulphuric acid, and zinc, as well as orthodox methods of obtaining other elements; some books vary the process by recommending expensive apparatus, others go to the opposite extreme of imagining all students trained mechanicians or artizans. Few of the text-books detail fully the method of preparing, say hydrogen, from the action of sodium upon water, the decomposition of water by electrolysis, by heated oxidisable bodies, &c.; but among the number who are content to treat chemistry as an experimental science, Mr. Valentin ranks in the first order. His book records the neatest modes of preparing an experiment, and the bearing of the experiment upon the general theory of chemical science. As a practical handbook the student need go in search no farther, for while he is acquiring the facts here given he will be laying the foundation of a truly scientific education.

CORRESPONDENCE.

CHEMISTRY OF ACID MANUFACTURE.

To the Editor of the Chemical News.

Sir,—In your report of the transactions of the Manchester Literary and Phllosophical Society, page 307 of your last issue, you give an abstract of a paper "On some points in the Chemistry of Acid Manufacture," by H. A. Smith, F.C.S.

Is it in your power to give the whole of the paper? for as the report at present stands, I venture to think it is of but little service, no experimental data being given—no descriptions of the modes of experimenting. Indeed, it is temptingly provocative of adverse criticism, which further explanation might remove, and so convert the paper into a really valuable contribution on a most interesting subject.—I am, &c.,

Charles F. Burnard.

Dec. 28, 1872.

ANALYSIS OF MANURES.

To the Editor of the Chemical News.

Sir,—Having just seen Mr. Reynolds's proposition for a more correct scale of valuation for the constituents in artificial manures, I would like to draw his attention, as a primary question, to the means of ascertaining the relative proportions of the ingredients he names in manures. As yet it seems beyond the means of ordinary analyses. Mr. Reynolds admits a difference in the value of mineral and bone phosphates. If, then, a farmer buys a quantity of manure under the common name of "Dissolved bones" —if he sends a sample of this to a chemist, and requests to know whether all the phosphates present are bone, and if not, how much of them are from minerals, can the chemist tell this? We suspect not. We have heard chemists of very high standing confess that when dissolved they cannot tell, and even the portion not in a soluble condition, if equal ground, the proportions of the one and the other cannot be given. This is what farmers wish to know, and then the true value is of easy determination; and so long as bones are nearly double the price of mineral, and no positive means of determining when and to what extent they are mixed, the farmer will be at the mercy of the adulterator. The relative quantity of ammonia as such in a manure and ammonia latent is within ordinary analysis, and ought to be determined and relatively valued—a matter long overlooked. I would suggest that Mr. Reynolds turn his attention to the determining the relative quantities of bone and mineral phosphates when they are mixed in a manure.—I am, &c.,

J. Napier.

Glasgow, 25th Dec., 1872.

MISCELLANEOUS.

The Royal Polytechnic.—Never was a more attractive or more varied programme issued from this institution than that provided for the Christmas holidays. It includes a lecture by Professor E. V. Gardner, F.E.S., M.S.A., on the History of a Plum Pudding, an amusing entertainment by Mr. George Buckland, and a ghost illusion entitled "The White Lady of Avenel," the incidents of

which are taken from Sir Walter Scott's tale of the "Monastery." It has been skilfully arranged by one of the Directors, Dr. Croft, who takes a lively interest in, and devotes much time to, the interests of the Polytechnic.

London International Exhibition, 1873.—The second meeting of the Committee on Surgical Instruments and Appliances was held on the 23rd December, 1872, at 3 o'clock, in the offices, Gore Lodge, South Kensington. Among those present were Mr. Cæsar H. Hawkins, F.R.S., in the chair, Sir William Fergusson, Bart., F.R.S., Dr. P. Allen, Mr. W. Bowman, F.R.S., Mr. B. Brudenell Carter, Mr. W. White Cooper, Dr. W. T. Domville, R.N., Dr. Arthur Farre, F.R.S., Dr. G. T. Gream, Mr. Prescott G. Hewett, Mr. J. Hilton, F.R.S., Mr. J. Hinton, Professor J. Marshall, F.R.S., Mr. T. W. Nunn, Dr. W. S. Playfair, Mr. R. Quain, F.R.S., and Mr. Edwin Saunders. Letters received from the Royal College of Surgeons, and the Royal Medico-Chirurgical Society were read, and it was stated that many of the leading surgical instrument makers in London, Dublin, Paris, and other capitals had signified their intention to contribute. It was suggested that the Exhibition should be brought before the notice of the British Medical Association at its meeting in August, 1873. The committee resolved to recommend the Royal Commissioners to invite corresponding members in foreign countries, and after the transaction of general business adjourned till Monday, the 20th January, 1873.

MEETINGS FOR THE WEEK.

Monday, Jan. 6th.—Medical, 8.
Tuesday, 7th.—Royal Institution, 3. Juvenile Lectures.
—— Anthropological, 8
—— Biological, 8½
Wednesday, 8th.—Geological, 8
Thursday, 9th.—Royal Institution, 3. Juvenile Lectures, Prof. Odling on "Air and Gas."
—— Royal, 8½
—— Royal Society Club, 6.
Friday, 10.—Astronomical, 8
—— Quekett Club, 8.

TO CORRESPONDENTS.

*** Vol. XXVI. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

A Student.—The Chemical News is the only one.

X. Y. Z.—Dr. Morfit's work. It has been reviewed, and also advertised in our pages.

In our report of the discussion of the Chemical Society, p. 306, for Mr. *Prosjean* read *Grosjean.*

THE CHEMICAL NEWS.

VOL. XXVII. No. 685.

ON A SOURCE OF ERROR IN THE VALUATION OF PYRITES.*

By NICHOLAS GLENDINNING and ALFRED J. M. EDGER.

THE great consumption of pyrites in industrial chemistry renders the accurate determination of the sulphur it contains a matter of great commercial importance. Judging however, from the serious discrepancies which so frequently occur in the results obtained by different chemists when operating upon the same sample, it would appear that the estimation of sulphur is either surrounded by great difficulty or performed under very defective manipulation.

It will be quite within the recollection of the members of this society that their attention was drawn by a late president (Mr. Glover) to the differences observable in the results obtained by different experimenters. This gentleman explained that in seven samples, each tested by two professional chemists, there was a maximum difference of 1·9, a minimum of 1·4, and an average of 1·6 per cent of sulphur, but differences still greater have come under our own observation. This subject was afterwards noticed by Messrs. Teschemacher and Smith in their article "On the Estimation of Sulphur by Barium," published in the CHEMICAL NEWS, vol. xxiv., p. 61. They were of opinion that the observed differences might be traceable to different methods of testing, and adduced a number of results by way of proof that the method then in general use was not reliable.

Shortly after the appearance of their article we published results in support of that method (see CHEMICAL NEWS, vol. xxiv., p. 140), and we now beg to draw your attention to a source of error which precedes the analytical process, and precludes the possibility of correct results being obtained,. We allude to the use of the wedgwood mortar in the preparation of the portion for analysis, and are persuaded that its use obtains very generally in both professional and private laboratories.

In the midst of all the contention respecting the differences between results, it does not seem to have occurred to the experimenters that the cause of difference might be introduced in the preparation of the sample; and yet it must have been observed that, to whatever use a wedgwood mortar has been applied, a very perceptible wearing is effected in course of time. A few years ago we devoted some attention to the differences which were causing so much annoyance; and from the circumstance of mortars becoming somewhat worn, we inferred that this might be the solution of the problem, and subsequent experiments proved the accuracy of this conclusion.

We prepared a sample by passing it through a sieve of 529 meshes to the inch to ensure uniformity of composition, and then reduced portions to an impalpable powder for analysis; and then estimated in the several portions the sulphur and sand. The sulphur results were found to differ to an extent in some cases of upwards of 2 per cent, and this was accounted for by the amount of sand found in their respective portions. We at once saw that the wedgwood mortar was quite unsuited to the purpose, and have since prepared samples in a different way. We will now proceed to lay before you some results obtained quite recently from samples prepared in various ways.

1. A sample of pyrites was passed through a sieve of the above description, the coarser particles being reduced in a hard wedgwood mortar, and after thorough mixing a quantity was reduced to an impalpable powder in the same mortar. Two determinations of the sulphur and sand in the portion gave the following results:—Sulphur, 45·08 per cent; sand, 8·92 per cent; and sulphur, 45·04 per cent; sand, 8·88 per cent.

2. Another portion of the sifted sample was similarly reduced in a wedgwood mortar, which had been in use for some considerable time previously (this mortar was perceptibly softer than that used in the preceding experiment). Two determinations of sulphur and sand gave—Sulphur, 43·56 per cent; sand, 11·52 per cent; and sulphur, 43·44 per cent; sand, 11·50 per cent.

3. Another portion of the same sifted sample, reduced in an agate mortar, gave in two determinations:—Sulphur, 46·28 per cent; sand, 6·2 per cent; and sulphur, 46·15 per cent; sand, 6·24 per cent.

4. A duplicate sample of the same ore, instead of being ground in a wedgwood was reduced in a steel mortar, and a portion brought to an impalpable powder in the agate, two determinations giving:—Sulphur, 46·25 per cent; sand, 6·11 per cent; and sulphur, 46·36 per cent; sand, 6·13 per cent. The following is an arrangement of the results in a tabular form:—

Sulphur per cent.	Sand per cent.	Average Sulphur per cent.	Average Sand per cent.
1. Wedgwood mortar alone—			
45·08	8·92	45·06	8·90
45·04	8·88		
2. Wedgwood mortar alone—			
43·56	11·52	43·50	11·51
43·44	11·50		
3. Wedgwood and agate mortars—			
46·28	6·20	46·21	6·22
46·15	6·24		
4. Steel and agate mortars—			
46·25	6·11	46·30	6·12
46·36	6·13		

It will be observed that the difference between the results of Nos. 4 and 2 is, sulphur 2·80, and sand 5·39 per cent; and between Nos. 4 and 1, sulphur 1·24, and sand 2·78 per cent; whilst between Nos. 4 and 3 there is only the slight difference of sulphur 0·09, and sand 0·10 per cent.

Duplicate samples of another pyrites were tested by a metropolitan professional chemist, a local professional chemist, and ourselves, with the following results:—

	A.	B.	C.	
Sulphur per cent	43·8	45·5	46·84	46·8
Sand per cent	8·3	8·1	5·60	5·5

We may mention that A represents the results of the metropolitan chemist, and B those of the local chemist.

Our sulphur results were obtained by the method described in our article in the CHEMICAL NEWS before alluded to, which we can, with great confidence, recommend as capable of giving concordant and reliable results.

We may remark that the sulphur result of No. 2 is not sufficiently high by 0·3 per cent if the difference between its sand and that of No. 4 be taken as the full extent of the contamination. We have, however, so repeatedly found this to occur that we assume that some portion of the detached mortar is soluble in the acids employed—probably not the wedgwood itself, but matter which the mortar may have absorbed during its use, It is obvious from these results that by using the wedgwood mortar very serious differences may arise, their extent varying of course with circumstances, *e.g.*, the hardness of the sample, the hardness of the mortar and its condition, and the industry of the operator.

In conclusion, we hope we are justified in assuming that the results we have had the pleasure of laying before you afford sufficient proof that the use of the wedgwood mortar involves a more or less serious depreciation of the

* Read before the Newcastle-on-Tyne Chemical Society, Dec. 19, 1872.

sample, and that under these circumstances the probability of the attainment of a result representing the true value of the sample as it reached the assayer's laboratory is of a most remote character, and an occurrence which can only be due to an error in analysis.

Note. Since reading the above paper, we have made experiments substituting the porcelain in lieu of the weedgwood mortar in the preparation of the test sample, and the results obtained show that it also contaminates the sample to a serious extent, as will be seen from the following results:—A sample of the same pyrites as was used in the preceding experiments (and which gave by the steel and agate mortars in two determinations—Sulphur, 46·25 per cent; sand, 6·11 per cent; and sulphur, 46·36 per cent; sand, 6·13 per cent) gave when the porcelain mortar was used—Sulphur, 45·3 per cent: sand, 8·21 per cent; and sulphur, 45·36 per cent; sand, 8·23 per cent. Or, comparing their averages, the results of the porcelain mortar show an excess of 2·1 per cent of siliceous matter, and a deficiency of 0·97 per cent of sulphur.

ON THE ESTIMATION OF MANGANESE IN PIG-IRON, STEEL, AND WROUGHT-IRON.

By F. KESSLER.

As, in these days, iron which contains more or less manganese is considered to be more or less valuable, it occurred to me to try to devise a method whereby the estimation of manganese in the above-named materials might be rendered more expeditious and less liable to the errors ordinarily inherent in that estimation. At a future period I intend to publish an exhaustive account of my researches; I therefore now communicate only what is of direct practical utility.

When a hydrochloric acid solution of perchloride of iron is neutralised by means of carbonate of soda, so as to cause a permanent precipitate, and the latter is cautiously re-dissolved by the addition of some hydrochloric acid, a liquid is obtained which contains fourteen times its equivalent of ferric hydrate in solution, yet it is not precipitated by boiling. In order, therefore, to precipitate the iron by means of acetate of soda, aided by boiling heat, there is, theoretically, only as much acetate required as is sufficient to convert the chloride into acetate, viz., 3 molecules of acetate to 15 atoms of iron, or 1 part, by weight, of crystallised acetate of soda to 2 parts, by weight, of iron. It is, indeed, an easy matter to precipitate completely, by boiling, from previously carefully neutralised iron solutions, 1·1 grm. of iron upon 500 c.c. of fluid by means of 1 grm. of acetate of soda, even when, in order to prevent the possible decomposition of other acetates, 1 grm. of acetic acid had been added. Under these conditions, only very small portions of manganese are thrown down along with the iron—for instance, from 13 per cent only about 0·02 to 0·05 per cent, and less when the quantity of manganese is smaller.

From what has just been stated, it is quite evident that the loss often experienced in the estimation of manganese by the method just alluded to is mainly due to the fact that too large a quantity of acetate of soda is employed, in consequence of which a portion of the chloride of manganese is also converted into acetate, which salt is readily decomposed into protoxide and acid, a fact almost entirely overlooked. It is probable that my improved method may also be applied to the separation of iron from zinc, copper, nickel, and cobalt, Before I found out this method I used sulphate of soda, for decomposing the previously neutralised chloride of iron. Although this salt may even be used in excess without any manganese being precipitated, I found that 1 grm. of it is sufficient to separate 1·1 grm. of iron; only a very small quantity of it remains in solution, and this quantity does not vitiate the results. In order to obviate the washing of the precipitate, I dilute the previously-cooled fluid to 500 c.c. I next filter it through a dry filter, and take 250 c.c. of the filtrate, equal to 0·55 grm. of the quantity of the material originally taken, and in these 250 c.c. I estimate the manganese. When the manganese is intended to be precipitated by a further addition of acetate and bromine, and the quantity of dioxide of manganese then acidimetrically determined, we again meet with the difficulties occasioned by the ready decomposition of the acetate of manganese, and the capability of the dioxide of entering into combination with the lower oxides of manganese, and consequently the protoxide. These difficulties are best met by the following method of operation:—10 grms. of sodic acetate are dissolved in 150 c.c. of water, 50 c.c. of bromine-water are added, and, at intervals of half an hour, 50 c.c. of the manganese solution, care being taken that at the third half-hour 50 c.c. of bromine-water be again added to the fluid, to which heat should not be applied.

In this manner, the manganese dioxide is thrown down from so dilute a solution that only from 0·02 to 0·03 per cent of manganese out of 13 per cent are lost in the shape of protoxide. On the other hand, small, but, with the whole quantity, proportional, quantities of manganese remain, either in solution as permanganate, or are so fixed to the sides of the glass vessel in which the operation takes place, that it is necessary to re-dissolve it. After the free bromine has been driven off by heat, the precipitate is filtered off, washed with dilute solution of acetate of soda, and then treated, together with the filter, with from 5 to 15 c.c. of a solution of chloride of antimony (1 to 5) and 15 c.c. of concentrated hydrochloric acid, after which the fluid is diluted with 100 c.c. and titrated with decimal permanganate solution, 1 c.c. of which then equals 0·5 per cent of manganese. When the quantity of manganese is less (below 1 per cent), all quantities are tripled, and 5-6ths of the filtrate from the iron precipitate, previously concentrated by evaporation, are treated for manganese, 1 c.c. of permanganate becoming in this case equal to 0·1 per cent of Mn.

The titre of the solution of permanganate is found, either by comparing it with a solution of potassic bichromate of known strength by means of chloride of antimony, or by investigating a known quantity of pure protoxide of manganese according to the method described above. By mixing pure solutions of manganese (I often used for this purpose solutions of permanganate of known strength, with solutions of iron, the manganese in which had been previously determined, in variable proportions), I made mixtures for testing, in which the quantity of manganese varied from 0·1 to 13 per cent. As instances of at least four experiments, I quote the following:—

	Per cent Mn.						
Used..	0·118	0·218	0·568	1·051	3·050	7·048	13·045
Found	0·116	0·216	0·548	1·053	3·028	7·006	12·982
Difference	0·002	−0·002	−0·020	+0·002	−0·022	−0·042	−0·063

In order to elucidate the action of the sources of error, I precipitated, in direct contravention to the precept above quoted, the ferric hydrate by means of 15 grms. of acetate of soda, without adding free acetic acid, from 300 c.c. of fluid, and the loss of manganese for the undermentioned quantities was as follows:—

	Per cent Mn.			
	1·00	3·00	7·00	13·00
Loss	0·21	0·60	0·87	1·06

The loss was analogous, although less marked, when, deviating from the normal method, the manganese was thrown down at once in the total 210 c.c. of fluid by means of 15 grms. and 30 grms. of acetate respectively; for, by a quantity of 13 per cent of manganese as maximum, the loss amounted to 0·13 and 0·25 per cent respectively. I have further found that, as regards copper, nickel,

and cobalt, metals often present in iron in greater or less quantity, small quantities are thrown down along with the manganese precipitate, copper and nickel only as monoxides, but cobalt as sesquioxide; the latter, therefore, unless it be separately estimated, may bring on a slight error, so that the quantity of manganese would be found somewhat too large, viz., about half the quantity of the cobalt present.—*Ber. d. Deutsch. Chem. Gesells.*

THE ESTIMATION OF SULPHUR IN PYRITES.

By PHILIP HOLLAND.

THE practical importance of providing a reliable method for estimating sulphur in pyrites has, I need hardly say, been fully realised by chemists who are called upon to make assays of this kind.

The experiments detailed in the present communication, some of which have yielded but indifferent results, were made, not so much with a view of arriving at an entirely new scheme for valuing sulphur ores, but rather to supplement our present ways and means of conducting the operations now in vogue. For most purposes, I think it may be assumed that sulphur in mineral substances is usually, if not invariably, determined as sulphate of barium, and that there are four methods in general use for this purpose—three direct, and one somewhat indirect. The direct comprise a gravimetric and two volumetric processes. The indirect is also a volumetric one, and is known as Mohr's alkalimetric method, useful in many cases, but scarcely applicable to the valuation of pyrites, since the conditions of an assay are not usually such as readily to adapt themselves to it. I tried the following alkalimetric process, which I believe has been already described by Bohlig (*Fresenius's Zeitschrift*) for estimating sulphuric acid, with the intention of applying it to the valuation of pyrites. It was soon evident, however, that the experimental conditions of an assay are not such as to adapt themselves readily to it.

If hydrate of barium be added to a neutral solution of a sulphate of an alkali, and the excess be removed by CO_2, the amount of caustic alkali liberated will be equivalent to the sulphuric acid previously combined in the absence of phosphates and fluorides. The solution containing the soluble sulphate in the presence of free HCl is precisely neutralised whilst boiling with sodium carbonate free from sulphuric acid. Hydrate of barium is then added in slight excess, the whole boiled for a few minutes, and the excess removed by CO_2. After filtration and thorough washing of the residue on the filter by boiling-water, the filtrate is neutralised by standard acid. The following experiments were made; the volume of fluid was in each about 250 c.c.:—

Amount of Standard Sulphuric Acid taken.	Amount of SO_3 in grammes.	Amount of SO_3 found.	Per cent of SO_3.
c.c.			
2	0·08	0·080	4·00
4	0·16	0·158	3·95
6	0·24	0·220	3·66
8	0·32	0·300	3·75
10	0·40	0·368	3·68
12	0·48	0·460	3·83
14	0·56	0·515	3·67
16	0·64	0·600	3·75
18	0·72	0·688	3·82
20	0·80	0·762	3·81
30	1·20	1·100	3·66

I may remark that the burette used to measure the standard acid at the commencement of the experiment was the one which measured the same acid when titrating the alkali, consequently the amount of acid used in the latter part of the process should have precisely equalled that in the first stage had there not been a loss of alkali. Some of the experiments were repeated, and similar results were obtained; the error was always one of deficiency when the sulphuric acid was about half a gramme. The low results are doubtless due to the fact that boiling water fails to remove all alkali from the mixed precipitates, which is not at variance with our present knowledge of the properties of barium precipitates generally. I did not continue this enquiry further, inasmuch as it did not seem probable that closer numbers would be obtained unless the process was inconveniently prolonged.

The next method to which some attention was paid is the direct volumetric one of Wildenstein, which has lately been carefully studied by Messrs. Teschemacher and Denham Smith; I am able to confirm much that these chemists have said about it in several particulars. My own experiments satisfy me that it is desirable to conduct the titration in the presence of but little free HCl, in the entire absence of nitric acid, and to standardise the barium chloride by iron sulphate, as nearly as possible under the conditions which will prevail in a pyrites assay so far as the amount of free acid and volume of fluid are concerned. Some little difficulty is experienced in deciding what shall be considered the end-point of the titration, owing to the so-called neutral point in the fluid when a drop of either barium chloride or sulphuric acid produces a slight turbidity.

I may just mention that up to a certain stage the testing for excess of barium can be done on a watch-glass. A drop of the partially clear solution is removed by means of a narrow tube pipette. A drop of the barium solution from the burette is brought near, and the two fluids allowed to run together. If the point of contact be carefully observed, the appearance of a faint opalescence will indicate sulphuric acid. The rapidity of the change and the depth of the opalescence serve to warn the operator of the approaching completion of his experiment. The absolute completion cannot be decided except on a filtered portion in a tube, and this can only be done under certain conditions, as the following observation testifies. Two measured equal volumes (4 c.c.) of the solution in a pyrites assay were taken, and to each was added respectively and at the same time one drop less than 0·1 of a c.c. of the normal barium, and a like amount of normal sulphuric acid. In the tube to which the acid was added a slight turbidity appeared at the end of a minute and a half; in the other tube the fluid remained quite clear. To the latter four additional drops of barium were added, when a turbidity showed itself in a few seconds. I am not able to give an explanation of the phenomenon. Perhaps sulphate of barium is slightly soluble in a solution not containing too large an excess of $BaCl_2$? Whatever may be the explanation, the reaction must be taken into account when verifying the strength of the barium chloride.

In assaying pyrites for sulphur only by the fusion method, I have worked as follows and obtained good results. The process will no doubt be useful in laboratories which do not possess large platinum crucibles. A test-tube or piece of sealed combustion-tube, about six inches long and half an inch internal width, is fitted with a cork and delivery tube, the latter bent at a right angle and long enough to reach to the bottom of the flask in which it is intended to make the titration. The fusion mixture consists of equal parts of nitre and ignited acid carbonate of sodium, both free from sulphur, dry, and in fine powder. Nine to ten grammes is taken in an operation, together with one of pyrites, the latter must be in exceedingly fine powder; the two are mixed in a warm porcelain dish or agate mortar, and transferred to the tube without loss. The delivery tube is then inserted with its extremity dipping into the flask. A channel is made on the surface of the mixture, and the tube suitably supported is heated in small portions at a time with a Bunsen gas flame, commencing as usual with the anterior portion. When the operation is progressing favourably, the deflagration proceeds for a few seconds after removing the flam

There is no danger to be apprehended, and the tube does not crack or blow out with proper care. When the tube has been heated throughout, and the deflagration has ceased, it is then more strongly heated with a Herapath or powerful gas flame. It is a good plan at this stage to slip a coil of wire gauze over the tube, which helps to accumulate the heat. It is not, however, necessary that the contents should be fused a second time, at least this has not been done in experiments appended. The sulphur ores examined have yielded their sulphur readily.

The gaseous products of the combustion which mechanically carry over with them small quantities of sulphates or sulphuric acid, being heavier than air, collect in the flask, and are washed by shaking with a little water, closing the flask with the palm of the hand. The delivery tube is also washed. That containing the fused mass is carefully broken and put in the flask, together with sufficient hydrochloric acid to dissolve nearly the whole of the iron oxide; then ammonia is added, until a precipitate of oxide reappears, and lastly as much free HCl and water as are necessary to bring the fluid to the conditions which obtained when the barium solution was standardised. I have used 2 c.c. of free acid, and the total volume of solution was 200 c.c.

Experiments have been made on three samples of iron pyrites. The one containing the most sulphur has a bright crystalline fracture, and appears to contain but little siliceous matter. I have not made a complete analysis of it, as I wish to reserve a specimen. It was given to me by the landlord of a small inn at Macugnaga in the Val-Anzasca, near which place a mining company has been established to work the vein. The mineral is said to contain gold.

I am uncertain of the source of the other two specimens. In the following experiments I have compared the results obtained by the method of working just described with those obtained by oxidising the sulphide with nitro-hydrochloric acid.

In some laboratories both processes are used in valuing sulphur ores. The tables give the sulphur per cent on the dry sample.

	(1) Val-Anzasca.		(2)		(3)	
	By oxidation with acid.	By fusion.	By oxidation with acid.	By fusion.	By oxidation with acid.	Fusion.
	50·39	50·52	47·46	47·33	45·85	45·85
	50·44	50·44	47·38	47·46	45·81	45·75
	50·52	50·37	47·44	47·54	45·77	45·84
	50·50	50·38	47·38	47·49	45·69	45·79
	50·39	50·52	47·33	47·46	45·84	45·83
	50·52	50·52	47·54	47·38	45·85	45·76
Mean	50·46	50·45	47·42	47·44	45·80	45·80

A single gravimetric determination was made on the Val-Anzasca specimen; the number obtained was 50·44. Nitro-hydrochloric acid was used to oxidise the sulphur, and the excess was removed by evaporation at 100° C. before adding the barium salt; the precipitation was made in the boiling solution, which was somewhat dilute.

The chief cause of failure in conducting a fusion as above described is the possible incomplete oxidation of the sulphur. Such is rarely the case, provided the heat is sufficient and the mineral finely divided. To insure the latter condition it is desirable to sift the dry sample through muslin.

I have not had an opportunity of extending the method to sulphur minerals generally, but there is little doubt that most, if not all, can be decomposed in this manner without loss of sulphur—that is to say, if ordinary precaution be taken. An anterior layer of fusion mixture may be dispensed with, and it is not necessary to rinse the dish; a camel-hair brush will remove any remaining particles both from it and the mouth of the tube.

DETECTION AND ESTIMATION OF PARAFFINE IN STEARINE CANDLES.

By M. HOCK.

Makers of stearine candles mix paraffine with the fatty mass in quantities up to 20 per cent. Paraffine candle makers also mix stearic acid with their paraffine, and attribute valuable properties to such a mixture, so far as candle-making is concerned. The attempt to determine if paraffine be present, and if so, to get some approximate idea of the quantity, in a sample of stearine and *vice versa*, by means of the comparison of the melting-point and specific gravity of such a mixture, is shown to be useless, as these vary according to the source from which the paraffine is obtained, as also in the case of the stearic acid, since the pure commercial article is by no means a chemically pure article.

A good method for detecting the presence of stearic acid in paraffine has been devised by R. Wagner, viz., by treating a boiling solution of the paraffine in alcohol with an alcoholic solution of neutral acetate of lead, when, if stearic acid be present, a dense floccular precipitate appears, but none if it be absent. The best method, and one which can be used quantitatively as well as qualitatively, is described as follows:—

Not less than 5 grms. of the candle are taken and treated with warm solution of hydrate of potash, which must not be too concentrated. A soap is formed with the stearic acid, whilst the paraffine is left unaltered. Salt is thrown into the solution, whereby the soap is separated out as a soda soap, and in precipitating takes down the paraffine with it. The soap obtained is thrown on the filter and washed with cold water or very dilute spirits of wine. Thus, firstly, the salt is washed out, and finally, the soap is brought into solution and likewise washed through the filter, leaving the paraffine, which is then dried at a temperature below 35° C., so as not to fuse it. The paraffine is then treated on the filter with ether, and after repeated washing with this solvent, the ethereal solution is carefully evaporated in a weighed porcelain crucible, in the water-bath, at a low temperature. The residue, consisting of the paraffine, is then weighed, and the stearic acid is estimated by difference.

ON THE MEANS OF REGULATING GAS-FLAMES SO AS TO OBTAIN A CONSTANT TEMPERATURE HIGHER THAN THE BOILING-POINT OF MERCURY.

By J. MYERS.

Jeannel* and Martenson† have recently published descriptions of regulators of temperature, by means of which a constant temperature higher than that of the boiling-point of mercury may be kept up. It is unnecessary to enter here into details of the construction of these apparatus; suffice it to say that air is applied in them as the expanding medium.

While engaged in a series of experiments on the process of dissociation of oxide of mercury, I required a high, but constant and only slightly varying, temperature for a considerable length of time, and for that purpose constructed a modification of Schlösing's apparatus, in which, in lieu of a mercury-reservoir, an air-reservoir is used, consisting of four glass tubes placed side by side and tied to each other, each tube 15 centimetres long by 2 centimetres diameter, This apparatus was placed into an air-bath, through a slit cut in the top of it, at the side where the door is placed, care being taken that the bath is air-

* *Polyt. Journ.*, No. 204, p. 460; *Chem. Centralbl.*, 1872, p. 497.
† *Pharm. Zeitschr. f. Russland*, 1872, No. 11, p. 136; *Chem. Centralbl.*, 1872, p. 513.

tight, while it is heated by means of gas, which can be supplied at any desired pressure. When it was desirable to heat the bath to a high temperature, say 250°, the quantity of gas required for that purpose was found too large to be regulated by the apparatus, since the distance between the supply-pipe of the gas and the caoutchouc caps (probably those connecting the above-mentioned glass tubes) had to be made too great, this being due to the great loss of heat (by radiation) from the non-heated sides of the air-bath, which, in order to be heated to the boiling-point of mercury, requires a very large bulk of gas.

It is through the kindness of Professor Gunning that I have been enabled to make these experiments, because, as the pressure usually kept up in street-gas-mains is not strong enough for this purpose, I was compelled to supply gas to the burners by means of a separate gas-holder. When the supply of gas reached a given pressure I was enabled to bring the temperature of the air-bath up to 350° by the use of four Bunsen burners, which temperature could be kept up constantly with very slight variations; with five such burners I could bring the temperature up to 362°. It is of course evident that neither Jeannèl's or Martenson's instruments, nor my own, can be used for regulating temperatures above that of the boiling-point of mercury, an observation more particularly applicable to the apparatus of the first-named gentleman, in which the outlet opening is very small; perhaps by placing the instruments in a bath of molten metal (lead or zinc, for instance) regulation of the temperature might still be possible, but the instruments are not well suited for such use. If an air-bath were so constructed that the loss of heat from the metal by radiation were either entirely prevented or greatly reduced, it might be possible for my modification of Schlösing's apparatus, if of larger size, to be found to answer for regulation and constant maintenance of higher temperatures; as long as this is not effectually done we need not hope to be able to regulate high temperatures. I say this because the assertion to the contrary made by Martenson and Jeannèl, based simply upon the fact that air is the expanding medium in their apparatus, is not proved by facts. The instrument used by me enables me to regulate with great precision the temperature of either an air- or oil-bath, since the limit of variation of temperature is only about ½°. The volume of air heated in my instrument is greater than in those alluded to, and my instrument is also more air-tight than theirs; I can therefore, upon experimental grounds, recommend the use of my modification of Schlösing's apparatus whenever a very constant and only slightly varying temperature is required.—*Ber. d. Deutsch. Chem. Gesells.*

ON SOIL ANALYSES AND THEIR UTILITY.*

By EUG. W. HILGARD, State Geologist of Mississippi.

(Continued from p. 8).

A much graver defect is the failure to determine separately the organic matter ("humus") and the chemically combimed water; and to this is owing, in a measure, the unsatisfactoriness of the analyses as regards information on the physical character of the soils. A large amount of water of hydration indicates in ordinary cases a correspondingly clayey soil, where heaviness in working may, or may not, be relieved by a large amount of "humus." The "volatile matter" item, however, gives us no information whatsoever on these vitally important points; and there is, unfortunately, no *simple* method by which the determinations in question can be effected even approximately. That they *should* form part of every soil analysis is obvious, if only on account of the importance of "humus."

I have attempted to obtain a reliable scale of the different degrees of "heaviness" of soils, from the determination of their maximum absorption of hygroscopic moisture at ordinary temperatures. I find that at temperatures from about +7° to +21°, the amount of aqueous vapour absorbed by a thin layer of soil exposed to a *saturated* atmosphere remains very nearly constant, being for

Very sandy soils, ...	1·5 to 2·0 per cent.
Loam soils, ...	5·0 to 8·5 ,,
Clay soils, very heavy ..	12·0 to 15·0 ,,

there being of course, all intermediate grades of hygroscopic power, as well as of "heaviness." It appears that for this interval of temperature the decrease of absolute absorbing power in the soil, resulting from the rise of temperature, is just balanced by the increased amount of vapour diffused in the air—not an unimportant circumstance with regard to vegetable life.

There are, however, two soil ingredients which interfere seriously with the correctness of the estimate as to "heaviness," derived from the coefficient of absorption, viz., *humus* and *ferric oxide*. Both of these are highly hygroscopic, yet both *counteract* the "heaviness" caused by excess of clay. Moreover, there is a class of soils (viz., fine siliceous silts) whose exceeding "heaviness" in cultivation is much complained of, yet whose absorbent power is very small.

When, as in the majority of cases, the surface soil has been directly derived from the subsoil, the disturbing effect of the "humus" may be sensibly eliminated by comparing, not the soils, but the subsoils, in this respect.* As to the ferric oxide, there are among about 200 Mississippi soils analysed but three or four whose agricultural qualities would have been seriously under-estimated by a reliance upon the coefficient of absorption alone.

But I do not for a moment admit that in a material so complex, both in its composition and mode of action, any one or few data, whether chemical, physical, or agricultural, may be relied upon to characterise the soil: or, as Professor Johnson expresses it, "to do violence to agriculture." So far from this, I consider that a proper interpetration of the analytical results must take into consideration, not only all the chemical and physical facts observed on the specimen, but all that has been or can be observed *in loco*—the location, depth, derivation, relations to drainage, &c.; as well as all that is known concerning the qualities or peculiarities of the soil, both in its natural state and in cultivation. As Professor Johnson says, it should "form part of a system of observations and trials; must be a step in some research; must stand, not as an index to a barren fact, but as the revelator of fruitful ideas."

Such, precisely, has been my object from the beginning of my researches on the soils of the Mississippi, for sixteen years past. Clearly, the difference between Professor Johnson's position and mine is one of degree only; yet this difference is not a slight one, since while, as before remarked, I have made, or caused to be made, some 200 analyses of soils and subsoils, his classic works on the growth and nutrition of plants do not contain so much as a tabular exemplification of the composition of various soils, as resulting from chemical analysis. If, then, "the probabilities of its uselessness in direct application to practice are so great," as Professor Johnson seems to hold, I have committed a grievous error, and squandered the substance of the State.

I think that the considerations already adduced should plead measurably in extenuation of my course. But I will now state succinctly what services, in my view, soil analyses may fairly claim to be capable of performing, when conducted substantially in the manner, to the extent, and under the conditions defined above.

I take it for granted that, if in the determination of the mineral ingredients we were able to distinguish clearly from one another the portion immediately available to

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* Read at the Dubuque Meeting of the Am. Assoc. Adv. Sci., August, 1872.

* In such cases, the surface soil is always more sandy than the subsoil.

plants from that which is in an unavailable form, we would go far toward accomplishing what was originally claimed for soil analysis; and this Dr. Peter attempted to do by treatment of the soils with carbonated water. It cannot be doubted, however, that plants, as well as agriculturists, have at their disposal much more powerful, or at lest more *energetic*, solvents; and that, therefore, a determination of those ingredients which may fairly be considered practically within the reach of agriculture, must go deeper than does that with carbonated water.

Opinions may differ widely as to the proper strength and nature of the solvent ("*Aufschliessungsmittel*") to be selected. Hydrofluoric acid, or ignition with the alkaline earths, would evidently go too far; as no soil, probably, will ever yield up the whole of its nutritive ingredients to plants, and fertility is far from being proportional to the *whole* amount of potash, phosphoric acid, &c., contained therein.

When, however, a *partial* solvent of uniform strength is used in all cases alike, and its action continued for the same length of time, it may fairly be presumed that, *as between soils of similar origin*, the amounts so rendered soluble are, in a measure, proportional to the amounts of available nutriment present.

In using hydrochloric acid of the strength 1·11 to 1·12 sp. gr., obtained by slow steam distillation of stronger or weaker acid, rejecting the first and last portions, I have in most cases found quite a satisfactory agreement between the results so obtained and the experience of cultivators as to the productiveness and duration of the respective soils; always *provided*, that the difference in the amounts of inert sand present, of specific gravity, of depth of soil, &c., were taken into account.

The proviso is important, but that with a proper local knowledge these allowances *can* be made, and that in most cases the information thus gained regarding the nature and treatment of the soil will be vastly more complete and reliable than the judgment of any number of "old intelligent farmers," my experience has fully convinced me; witness the egregious mistakes daily made by such in the selection of new lands. Moreover, a small minority only of farmers is likely to possess the requisite "age and intelligence;" and it is quite important that the multitude of those less fortunate should have the benefit of all the help science can give them.

I will adduce but one "odious example" of a widely prevalent error in reference to the character of a class of soils that I have as yet been unable to eradicate, even from among the "old and intelligent;" who are unfortunately very much given to theorising on inadequate premises. Our prairie soils are notoriously limy; they are also "very sticky;" and the mud takes the hair off the feet of cattle, *Ergo*, every "sticky" clay soil in the State is called, considered, and treated as a "prairie" soil, especially if the hardened clods adhering above the hoofs of cattle should carry the hair with them. If such soil is unthrifty, and rusts cotton, it is because "there is too much lime in it," which "scalds" the seedlings. In matter of fact, most of these soils are notably deficient in lime, so as to be most directly and immediately benefitted by its application wherever it has been tried, in accordance with my suggestion. The lime here acts probably as much chemically as physically; the clay being rich in potash, as per analysis.* While the physical defects of these soils are doubtless the main cause of the crop failures, yet analysis has suggested a remedy which relieves, for the time being, from the necessity of the more costly improvements; lime being comparatively easy of access.

Analogous cases are far from infrequent, both in this and in the adjoining States; and I have been led to attach special importance to the determination of *lime* in soils, from the (not unexpected) rule which seems to hold good very generally, viz., that, *cæteris paribus*, the *thriftiness* of a soil is sensibly dependent upon the amount of lime it contains; while, at the same time, in the usual mode of culture without return to the soil, the *duration* of fertility is correspondingly diminished, and its cessation is very abrupt wherever much lime is present.

It may be said that, after all, this is but what, from data already known, might have been expected. Granted; then, *a fortiori*, soil analysis, involving the determination of lime, is of considerable use in determining the present and future value of soils.

In speaking of the "amount" of lime, I must be understood to refer, not so much to its absolute percentage, as to its quantity in comparison with that of potash, which, with phosphoric acid, is what all our fertilisers chiefly aim to supply. Their determination must, of course, be considered of prime importance, since their absence or extreme scarcity is fatal to profitable fertility; while, when they are present, even though *immediately* available for absorption to a slight extent only, we possess in lime, ammonia, &c., and the fallow, ready and powerful means for correcting their chemical condition.

Here again, the practical value of soil analysis is direct and indisputable. It is of no small interest to know whether the soil we intend to cultivate contains 0·75 per cent of potash and 0·25 of phosphoric acid, soluble in HCl, or only the fifth or tenth part of these amounts. *One* will bear improvement of all kinds—will pay for underdraining, terracing, &c.; while the other, quite similar in aspect perhaps, would not, according to Liebig's testimony, ordinarily be capable of profitable culture.

Again, it is well known that the same species of plants may occupy soils of widely different quality and value. True, an attentive observer will in such cases see differences in the mode of development;* yet these are often such as to escape ordinary remark, and grievous disappointments frequently arise from this source, with new settlers especially. It is of no small importance to be able to *identify*, as well as to distinguish, soils resembling each other; and this soil analysis can undoubtedly do, if there is any virtue in the law of probabilities even—admitting all that may otherwise be said against their reliability.

Even if no other direct benefits than those already mentioned could be obtained by the chemical and mechanical analysis of soils (which I do not admit, and expect to prove otherwise hereafter); even if we leave out of consideration the addition to our general knowledge which may fairly be expected to result from extensive series of such investigations, carried out upon a uniform plan, whereby accidental errors (whether caused by "birds or squirrels," or analytical and other mistakes) will be eliminated; even thus, I contend that the practical and theoretical value of soil analyses is sufficiently great to justify whatever labour and expenditure may be bestowed upon them by state and national surveys; and that the neglect with which this branch of research has of late been customarily treated, is the more to be regretted as no probable amount of private effort can accomplish what must, of necessity, be done on an extended scale and with the *prestige*, voluntary assistance, and interest not usually accorded to any but public enterprises. And with due deference to the author of the two volumes whose extraordinary merits no one appreciates more than myself, I call upon my colleagues in State surveys, especially in the West and South, to re-consider this subject before it is too late, and a legislative fiat declares their work to be "finished." It is true that the agricultural colleges must and will take up and continue, as far as possible, the investigation of the agricultural peculiarities of each State; but the special and local experience acquired by those conducting a field survey, as well as their opportunities for extensive and comparative observations, are unfortunately "not transferable," even to the finest quarto report. In order to attain their highest degree of usefulness, our agricultural

* See, for example, the article "Heavy Flatwood Soil," in my *Miss. Rep.*, 1860, pp. 276, 279.

* *Miss. Rep.* 1860, p, 203.

colleges should teach, not merely general principles, together with a sufficiency of the handicraft of agriculture; but they should be enabled to point out to each student, with reference to his particular neighbourhood, How Crops Grow, and How Crops Feed.—*Am. Journ. Sci.*

THE CHANGES WHICH COAL UNDERGOES BY EXPOSURE.

By H. ENGELMANN, E.M.

The subject of loss of carbon, or rather of deterioration, which stone coal suffers by exposure has of late attracted much attention amongst American mining engineers and metallurgists. The different coals are not equally affected by exposure. Their texture, their chemical composition, and the impurities which they contain, exercise considerable influence. Under otherwise equal conditions those stone coals suffer most which contain a large proportion of easily decomposed hydrocarbons, or which have little cohesive strength. Gas coals, after having been stored long, make less and poorer gas than when they are fresh from the mine, and coking coals lose their coking quality, more or less; some kinds are said to deteriorate very markedly within a few days after being mined.

The nature of the changes which take place with the coal, and the conditions which influence them, still form a fruitful field for investigation. A large number of interesting experiments on this subject were made by Dr. Richter, Professor at the Mining School at Waldenburg, in Prussia, which deserve to be far more widely known than they appear to be in this country at least. A detailed account of them may be found in *Dingler's Journal*, 1870. I will confine myself to stating some of his principal results. As soon as the coal is mined it begins to absorb oxygen, rapidly at first, then more slowly. At first this action appears to be physical, but it soon becomes chemical, when the absorbed oxygen combines with the hydrogen of the coal to form water, and, with the carbon, to form carbonic acid. Heat intensifies the chemical action. Powdered stone coal fresh from the mine, heated to a temperature between 350 and 400 deg. F., increased in weight; although carbonic acid and aqueous vapour are disengaged, more weight of oxygen is absorbed. After a while a rather constant weight is obtained, and, by chemical analysis, the coal is then found to contain oxygen and hydrogen very nearly in the relative proportion in which they combine to water, which has not been the case in the fresh coal. The property of the coal thus rapidly to absorb oxygen depends mainly upon its proportion of free hydrogen. Of the carbon of the coal only a few per cent (5 or 6) combine thus rapidly with the oxygen at the stated temperature, while the rest of the carbon is far more stable.

Different stone coals heated to the boiling-point of water until their weight remained constant, would absorb in a humid atmosphere at 60° F., from 2 to 7 per cent of water, and it was remarkable to observe that some solid pitch coal would absorb three times as much water as a soft laminated coal. The faculty of absorption could not be judged from the appearance of the coal, but coals from the same stratum exhibited considerable uniformity of behaviour. The coals which absorbed most water were also those which absorbed most oxygen. Twenty grm. coal absorbed in the first twenty-four hours after mining from 2 to 9 cubic centimetres oxygen. Stone coal absorbs carbonic acid even more eagerly than oxygen, taking up three times as much of it. At higher temperatures, the chemical action of the oxygen is increased, and a slow combustion takes place.

The influence of humidity on the deterioration of coal is complicated, and Dr. Richter's experiments did not lead to very definite results in that respect. Air-dry coal absorbs the oxygen far more rapidly than moist coal, and coal which has been artificially dried absorbs it still more eagerly, taking up at the same time some nitrogen from the air. On the other hand, humidity induces decomposition of the iron sulphuret contained in most coals, which in turn accelerates the chemical changes of the coal by creating heat, by causing it to split and slack, and probably, also, by inducing chemical action between the oxide of iron formed and the coal, if not between the oxygen and coal directly.

Light appears to exercise little influence. When coal has been exposed some time, and absorbs oxygen with little avidity, this absorption is a little greater in the dark. These were the principal results of Dr. Richter.

An interesting experiment was made some years ago in Germany to test the deterioration by exposure of Silesian gas coal. A quantity of coal slack was divided in three parts. One part was directly used in the gas factory, another after having been housed one month, and the third after one month's exposure in the yard. The relative proportions of gas obtained were 135, 111, 95. The losses by exposure were, therefore, 17·2 per cent and 29·5 per cent. The gas coke from the first lot was serviceable; from the second and third unserviceable.

It can hardly be doubted that this affinity of the oxygen for the coal has contributed much towards determining the quality of the coal which the different strata now present, but acting slowly in the course of ages, the effect has not been an apparent decomposition, but merely a difference of quality. The bituminous coking and gas producing coals have been least affected. They retain the largest proportion of hydrogen uncombined with oxygen and the least combined. The sinter or sand coals, which coke little or not at all, and furnish a poor gas, contain less hydrogen uncombined with oxygen, and more oxygen and hydrogen combined, than if they had been partly deteriorated by exposure. How little chemical equilibrium exists in a coal stratum is evident from the immense amount of carburetted hydrogen gas which is evolved in the coal mines, even in those which are not subject to dangerous accumulations of it in the form of fire-damp, and which in many, especially in deeper mines, can be heard escaping in minute bubbles from the sides of the rooms, making a peculiar noise. The quality of the roof and the quality and thickness of the superincumbent rock formations have exercised an important influence in determining the quality of the coal strata. Not seldom the deeper strata of a coal basin are the most bituminous ones. The more recent brown coals, the coals which are so extensively developed throughout the region of the Rocky Mountains, which are of cretaceous age, and present the appearance of stone coals, contain generally little hydrogen compared to their large proportion of oxygen. They should on that account not be apt to decompose readily, but the large amount of hygroscopic water which they contain, and their lack of cohesive strength, render many of them an easy prey to deterioration by exposure. I have seen many car-loads brought into this city (Salt Lake), of which the uppermost pieces, from an exposure of several days to the scorching sun and drying winds, were cracking and exfoliating very much like burnt lime in a moist atmosphere. These coals would certainly be of superior quality if they had been buried deeper in the bowels of the earth, and protected by heavy deposits of dense rock strata, which would have prevented the loss of so much of their bitumen, and rendered the access of oxygen more difficult. These coals are, however, not equally devoid of bitumen, and a locality in Sanpete Valley, U. T., presents a curious example of the influence of a solid casing. Near the village of Wales there is an outcrop of this brown coal, which is far more bituminous than the average. It is encased between solid beds of a slaty limestone, which forms a foot wall and roof of great stability. There is no clay seam or shale intervening. The whole thickness of the bed is about forty inches at this point, which appears to diminish to both sides, but it is not all coal. In its upper part it encloses several inches

of slate, and in its lower part an irregular seam of the same slaty limestone, from 0 to 10 inches in thickness. The coal itself is very solid, has a subconchoidal fracture, and, aside from the slate, contains a large proportion of ashes. Thus armour-plated against the inroads of decomposing agencies, it has retained considerable bituminous matter at the cost of purity. This coal is remarkable also on account of the vast number of small fresh water shells which are associated with it, and which must render it rich in phosphorus. Not only is the limestone above, below, and the coal full of these white shells, but the block slate is also crammed full of them, and even the coal itself near the slates.—*Engineering and Mining Journal.*

LIQUID GLUE PREPARED FROM SACCHARATE OF LIME.

A solution of 1 part of loaf-sugar in 3 parts of water, when spread on paper, imparts to it neither gloss nor strength, for the size does not adhere to the fingers when moistened. If, however, we add to the sugar the fourth part of its weight of slaked lime, and warm it to 145° to 165° F., then let it macerate some days, shaking it frequently, we shall find the greater part of the lime dissolved. The solution decanted from the lime sediment is then found to have the properties of mucilage, and a coat of it possesses gloss and firmness.

If we soak 3 parts of glue broken in small pieces in 12 to 15 parts of this saccharate of lime, then on warming it the glue dissolves rapidly, and remains liquid when cold without losing its strength, as glue does when treated with acid. Glue of any desirable consistency may be prepared by varying the amount of saccharate of lime added; the thicker glue keeps its muddy colour, the thin becomes clear on standing.

Gelatine dissolves in this solution of lime and sugar without previous soaking; even old gelatine, which has become insoluble in hot water, is soluble in this compound. This glue has great adhesiveness, and admits of very many uses; it cannot, of course, be used on colours that are injured by the lime, as, for example, chrome-yellow, Paris-blue, zinc-green, Behringer's green and carmine. Ponceau made from carbolic acid is changed into a beautiful carmine colour. When warming the glue to dissolve it, a strong smell of glue is given off, but this is destroyed by a few drops of oil of lavender; a small admixture of 2 to 3 per cent of glycerine is also an advantage. Carbonic acid acts upon the lime when the glue is exposed a long time to the air, producing little white specks, without, however, affecting its adhesive and preservative power.—*Journal of Applied Chemistry.*

PROCEEDINGS OF SOCIETIES.

ROYAL IRISH ACADEMY.

At the last general meeting of the academy, Dr. Sullivan read an interesting paper entitled "*Notes on the Ammonia present in Fungi.*" The author had been engaged in these investigations for many years. The present paper dealt more particularly with the chemistry of the common edible mushroom (*Agaricus campestris*). Dr. Sullivan was of opinion that the ammonia existed in the juice of the mushroom, and was not a product of decomposition. It might, and probably did exist in the form of an amide, and occurred in very large quantities. The author also gave it as his opinion that ammonia is constantly being eliminated from the plant during its growth.

Dr. Moore (Botanic Gardens) suggested that, in operating upon the mushroom, the chemist was really only examining the juices of the flower, and that therefore it differed, and was no criterion of the presence of ammonia in ordinary juices.

In the discussion that followed, Mr. Tichborne remarked that in boiling large quantities of the juice of the mushroom, volumes of ammonia were given off at one particular stage, which certainly tended to show that it existed in some such form as an amide, which at a particular temperature was split up into molecules of greater stability.

The Chairman (Professor Jellett) then detailed some experiments he had made in connection with the rotary power of mushroom juice in the saccharometer.

A second paper was read by Professor Sullivan, "*On the Dyeing Materials of the Ancient Irish.*"

MISCELLANEOUS.

Shaping Soft Rubber with a File.—We hear from Professor Morton, President of the Stevens Institute, that the ordinary thick sheet rubber used in making up lantern tanks and for many similar purposes, may be readily dressed into exact shape with a file, if only it is supported by being clamped between plates of wood or metal in the vice. The file is used dry, and in all respects as in working on wood or metal.

The Luminiferous Ether.—Though compelled to think of space as unbounded, there is no mental necessity to compel us to think of it either as filled or as empty; whether it is filled or empty must be decided by experiment and observation. That it is not entirely void, the starry heavens declare, but the question still remains: Are the stars themselves hung *in vacuo?* Are the vast regions which surround them, and across which their light is propagated, absolutely empty? A century ago the answer to this question would have been, "No, for particles of light are incessantly shot through space." The reply of modern science is also negative, but on a somewhat different ground. In support of the conclusion that the celestial spaces are occupied by matter, it is able to offer proofs almost as cogent as those which can be adduced for the existence of an atmosphere round the earth. The notion of this medium must not be considered as a vague or fanciful conception on the part of scientific men. Of its reality, most of them are as convinced as they are of the existence of the sun and moon. The luminiferous ether has definite mechanical properties. It is almost infinitely more attenuated than any known gas, but its properties are those of a solid rather than of a gas. It resembles jelly rather than air. A body thus constituted may have its boundaries; but, although the ether may not be co-extensive with space, we at all events know that it extends as far as the most distant visible stars. In fact it is the vehicle of their light, and without it they could not be seen. This all-pervading substance takes up their molecular tremors, and conveys them with inconceivable rapidity to our organs of visions. It is the transported shiver of bodies countless millions of miles distant which translates itself in human consciousness into the splendour of the firmament at night. If the ether have a boundary, masses of ponderable matter might be conceived to exist beyond it, but they could emit no light. Beyond the ether dark suns might burn; there, under proper conditions, combustion might be carried on; fuel might consume unseen, and metals be heated to fusion in invisible fires. A body, moreover, once heated there, would continue for ever molten. For, the loss of heat being simply the abstraction of molecular motion by the ether, where this medium is absent no cooling could occur. A sentient

being, on approaching a heated body in this region, would be conscious of no augmentation of temperature. The gradations of warmth dependent on the laws of radiation would not exist, and actual contact would first reveal the heat of an extra ethereal sun.—*Tyndall.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 23, 1872.

In addition to a series of papers strictly relating to other departments of physical sciences, this number contains the following original memoirs relating to chemistry:—

Action of Iodine upon some of the Hydrocarbons Belonging to the Aromatic Series.—P. Schutzenberger.—This essay contains the record of a series of experiments made with the view to ascertain the action of iodine under pressure (sealed tubes), and at a high temperature, upon certain hydrocarbons. Benzol gave a negative result; naphthaline was quite carbonised, but toluen is dehydrogenised, the result being the formation of new hydrocarbons—among these benzyltoluen, $C_{14}H_{14}=2C_7H_8-H_2$; and a red-coloured solid body, soluble in benzine and in chloride of carbon, fusion-point 100°, formula,—

$$2n(C_{14}H_{11})=2n(C_7H_8-H_5).$$

Reciprocal Conversion of Inactive Tartaric and Racemic Acids; Preparation of Inactive Tartaric Acid.—E. Jungfleisch.—Reserved for full translation.

December 30, 1872.

This number contains the following origina papers and memoirs more particularly relating to chemistry:—

On some Reactions of the Chlorides of Boron and Silicium.—L. Troost and P. Hautefeuille.—When the vapours of chloride of boron are caused to pass through a non-glazed porcelain tube at red-heat, the chloride is partly decomposed, chlorides of aluminium and silicium are evolved, and borate of alumina formed in the tube. If the chloride of boron is made to pass through a red-hot glazed porcelain tube the glaze is acted upon, and there is also formed, in addition to the chlorides above named, double chloride of aluminium and potassium. Pure chloride of silicium does not act upon porcelain even at the highest temperature; but both this chloride and that of boron under the same conditions act upon many other substances, such as zirconia, titanic acid, &c., forming chlorides thereof.

Quantitative Estimation of Manganese in Iron Ores, Pig-Iron, and Steel by a Colorimetric Process.—P. Pichard.—Reserved for translation, a remark also applying to the following paper:—

Volumetric Estimation of Small Quantities of Arsenic and Antimony.—A. Houzeau.

Presence of Methyliac in Methyl-Nitric Ether and in Methylic Alcohol.—M. Lorin.—It appears that on testing samples of methyl-nitric ether and of methyl-alcohol, the author found therein a substance which on being treated with hydrochloric acid yielded methyliac hydrochlorate. The process of the operation is described at great length, and it further appears that the samples operated upon were relatively pure.

Use of Cupric Liquors for the Estimation of Sugar.—L. Possoz.—When the cupric liquors used for the estimation of sugar are either treated with carbonic acid or with alkaline bicarbonates, there is precipitated from these fluids some carbonate of copper, while another portion of copper remains in solution. This (tartrate of copper and potassa, or of soda + alkaline carbonates) is not decomposed by pure cane sugar at temperatures between 60° and 95°, but is readily decomposed by inverted sugars. The fluid freed from caustic alkalies cannot give rise to the errors lately mentioned in various periodicals.

Researches on the Spectrum of Chlorophyl.—J. Chautard.

Annalen der Chemie und Pharmacie, No. 1, 1873.

On Sulphate of Iron Precipitated by Alcohol, and on the Quantity of Water Contained in the Double Sulphate of Iron and Ammonia, and of the Double Sulphate of Iron and Potassa.—L. Caro.—This paper, written chiefly to rectify some experiments made by Barckhausen and Rheineck, mainly confirms what is already known, viz., that the composition of protosulphate of iron precipitated by alcohol is the same as that of the crystallised salt; while, as regards the two other salts, Rheineck's statement as to their composition is proved to be erroneous.

On Hydrogen Shifting (Wasserstof Verschiebung) on the Carbon Skeleton (Kohlenstoff Skelet) of Organic Compounds.—W. Heintz.—This essay, illustrated by a series of complex formulæ, is not well suited for abstraction.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, August, 1872.

This number contains no original papers relating to chemistry, but we quote the title of Dr. Vom Rath's paper on—

The Crystallographic System of Leucite.—Illustrated by several engravings.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, Nos. 11 and 12, 1872.

These numbers contain no original papers relating to chemistry.

Bulletin de la Société Chimique de Paris, December 1, 1872.

The original papers in this number have been already abstracted from other French periodicals.

Le Moniteur Scientifique Quesneville, January, 1873.

Anthracen and its Derivatives.—E. Kopp.—The continuation and end of this exhaustive essay treats on the modes of applying artificial alizarine and purpurine, native alizarine, and the extracts of madder. There are a large number of practical receipts and directions for the use of the dyer and calico printer.

Memoir on Two Acids Found in the Mother-Liquors of Coralline.—A. Commaille.—This essay, treating on parathionic and thioamylic acids, and on an acid isomeric with sulphamylic acid, is a full account of the author's researches already alluded to (see CHEMICAL NEWS, vol. xxvi., p. 300).

Method of Purification of Rosolic Acid.—Ch. Girard.—In the introduction to this paper the author gives a *resume* of the methods by which pure phenol or cresylol may be converted into rosolic acid, while, further, the experiments of Wanklyn and Caro with rosaniline, and those of Liebermann with the same substance (the final result in each case being the formation of rosolic acid) are spoken of. The author next describes at length a rather complex process of purifying the rosolic acid obtained from either rosaniline or any of its salts by the aid of water under high pressure at 205°. The substances resulting from this reaction are first treated by the author with aniline, heat being applied. Thus there is formed azuline blue, which is first treated with hydrochloric acid, then washed with water, dried and reduced to powder; this is treated with caustic potassa. The insoluble residue is again treated with dilute hydrochloric acid, then washed with distilled water, and having been dried, the residue is treated with the vapours of either chloroform or crystallisable benzine; again dried, treated with alcohol, filtered, and the solution evaporated. The residue is treated, under pressure at 100°, with alcoholic potassa solution, whereby aniline is formed (from the triphenylic-rosaniline present in the matter), and rosolate of potassa, which, after the addition of water, is decomposed by an acid, yields flocculent rosolic acid. This is further purified, after washing and drying, by solution in boiling absolute alcohol; from the hot filtrate of that solution the pure rosolic acid is deposited on cooling in a crystalline state.

New Method of Preparing the Hair of Rabbits and Hares to be Used in Felt Hat Making, Without the Use of Mercury.—M. Hillairet.—A detailed account of some newly-devised processes, by the application of which the use of mercury may be avoided in the preparation of felt.

Preservation of Timber and Wood by Means of Tar.—Dr. Quesneville.—This essay contains a condensed account of the results of practical experiments made in France and Belgium by different persons to ascertain the value of tar as a preservative of timber, and the best methods of applying it.

Memoirs on the Estimation of Phosphoric Acid.—T' Schlœsing and G. Ville.

Bibliography.—Under this heading attention is called to the following work:—"Histoire de la Botanique, de la Minéralogie et de la Géologie Depuis les Temps les Plus Reculés jusqu'à nos Jours," par Dr. F. Hoefer, the eminent editor of the well known "History of Physics and Chemistry."

Although not belonging to chemistry, we call attention to the two following essays:—

The Floods of the Seine.—H. Parville.—This memoir contains not only important historical, but hydrographical and geological information concerning the causes of the rapid rising of the rivers in general.

Febrifuge and Anti-Periodic Properties of the Leaves of the Laurus Nobilis.—G. Doray.

La Revue Scientifique de la France et de l'Etranger, December 21, 1872.

Researches on Dulcite and Sugars in General.—Dr. G. Bouchardat.—This paper contains a brief *resumé* of the author's researches, published in the form of an inaugural dissertation. The first part treats on dulcite, and on the relation existing between that substance and the glucoses which yield mucic acid, and on the question whether all the glucoses can be viewed as the aldehydes of hexatomic alcohols. Next the action of different reagents (dilute acids, sodium amalgam) upon various kinds of saccharine substances is described; and in the second part of the essay the combinations of dulcite with acids is fully detailed. Dulcite as well as mannite are hexatomic alcohols, and the combinations with acids are veritable ethers.

Geology and Paleontology of Provence (South Eastern France).—A. F. Marion.—Illustrated by woodcuts and a map; an excellent lecture of the geology and paleontology of this locality.

Regularisation of the Heat in Warm-Blooded Animals.—Dr. Rosenthal.—A physiological essay.

December 28, 1872.

Bibliography.—Attention is called to "Histoire de la Céramique," par Albert Jacquemart, 1 vol.: Paris, Hachette, prix 25 francs. The author begins from the remotest periods of antiquity, and refers to all nationalities and countries.

Annales des Mines, No. 4, 1872.

This number contains no original papers relating to chemistry, but we call attention to the two following monographs.

Studies on Blast-Furnaces.—L. Gruner.

Notes on the Mechanical Preparation (Washing, Screening, &c.) of Coals, and on the Making of Coke Abroad and in France.—A. Pernollet.—These essays are copiously illustrated with engravings.

Journal de Pharmacie et de Chimie, December, 1872.

In addition to several original papers strictly relating to pharmacy, this number contains the following brief paper relating to chemistry:—

Action of Ether upon Iodides.—Dr. J. E. de Vry.—The author states, in reference to an observation made by Ferrières concerning the decomposition of iodides by ether, that several years ago he tried a similar experiment leading to the same result; but when the ether of commerce was first thoroughly shaken up with a concentrated solution of sulphate of protoxide of iron, and next with milk of lime, and then rectified by distillation, *no* action of the ether upon the iodides was observed. The author further observed that, while he resided in Java, he always ordered the ether sent to him from Europe to be rectified in the manner just described, because so treated it remained perfectly pure and without any action upon iodides even in that warm climate, provided the bottles containing it were well stoppered and kept quite full.

Les Mondes, December 26, 1872.

This number contains no original papers relating to chemistry, but it gives an exhaustive programme of—

A New High School for Agronomic and Forester's Sciences and their Application, to be shortly Inaugurated at Vienna.—It appears that this institution, founded by the Austro-Hungarian Government, will be in every respect, one of the most complete of the kind in Europe.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 5, 1872.

Manufacture of Stearine Candles.—M. Venèque.—The detailed accouut of this industry as carried on by the author.

Description of a Newly-Contrived Muffle Furnace to be Heated by Petroleum.—M. Wiesnegg.—This paper, illustrated by woodcuts, contains an account of muffle furnaces so constructed that petroleum may be used as fuel, according to a system devised by H. Sainte-Claire Deville.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 19' 1872.

From the protocol of the meeting, the proceedings of which are published in this number, we find that Dr. Oppenheim alluded to the fact that an eminent French *savant*, Aug. Cahours, desired to become a member of the Society; he regarded this as a sign of growing goodwill between the two nations, and of increasing oblivion of the past. He then briefly sketched the eminent scientific discoveries of Cahours, who was unanimously elected a member in the usual manner. The president, Dr. A. W. Hofmann, then communicated to the meeting that their fellow member, Dr. Heinrich Ludwig Buff, died at Prague on the 2nd of December last, at the age of forty-five years. The deceased, a well and deservedly known chemist, formerly one of Professor Liebig's assistants at Giessen, was Professor of Chemistry at the German Polytechnic School at Prague, and an industrious collaborator of many German scientific works, and one of the editors of the *Jahresbericht*.

The following original papers are also found in this number:—

Atomic Weight of Uranium.—C. Rammelsberg.—The contents of this essay, elucidated by a large number of formulæ, treat on the proposal made by Mendelejeff to double the atomic weight of uranium, which is thus brought from 120 to 240. The author points out the changes this makes in the formulæ of the uranium compounds, and the analogy thus effected with the compounds of molybdenum, tungstenum, and thorium. By taking the atomic weight of uranium as 240, it becomes the heaviest of all the elements.

Observations on Silicic Acid.—C. Rammelsberg.—The main gist of the first part of this paper is that the amorphous silicic acid, as frequently obtained in analysis, is only soluble after ignition, which renders it anhydrous in a boiling concentrated solution of carbonate of soda, or of potassa when the ignition was comparatively gentle; because, at a rather high temperature, although far below that of the porcelain-kilns, amorphous silica is converted, either wholly or in part, into the crystalline state (tridymite), and its sp. gr. is then 2·3. Some other amorphous bodies, berylla, titanic, zirconic, niobic, and tantalic acids, for instance, are similarly converted into crystalline bodies. In the second portion of this paper, the author observes that the quantity of water contained in silica, precipitated from alkaline silicates by acids, and dried, either over strong sulphuric acid or at 100°, varies, so as to exhibit hydrates of the formula $n SiO_2 + aq$, the value of n being in this case equal to from 4 to 8. Air-dried silica, even when apparently quite dry, may contain from 13 to 36 per cent of water.

Chlorine Derivatives of Aceton.—E. Mulder.—This exhaustive essay, elucidated by a very large number of formulæ, treats on the mode of preparation and properties of dichloraceton, a monochloraceton, and on the combinations of the former with hydrosulphuret of potassium and cyanide of potassium. The author incidentally observes that monochloraceton becomes of a beautiful carmine colour by the addition of excess of caustic potassa solution.

Diglycolamido Acid Diuramide.—E. Mulder.—This essay, containing a large number of complex formulæ, treats, after referring to Baeyer's researches on the synthesis of hydantoin, on diglycolamido acid diuramide—

$$\left.\begin{array}{l} NH_2\text{---}CO\text{---}NH\text{---}CO\text{---}CH_2 \\ NH_2\text{---}CO\text{---}NH\text{---}CO\text{---}CH_2 \end{array}\right\rangle NH,$$

a colourless, crystalline body, insoluble in alcohol, slightly soluble in cold, and more so in hot, water; combines with platinic chloride. It also treats on triglycolamido acid triuramide—

$$\left.\begin{array}{l} NH_2\text{---}CO\text{---}NH\text{---}CO\text{---}CH_2 \\ NH_2\text{---}CO\text{---}NH\text{---}CO\text{---}CH_2 \\ NH_2\text{---}CO\text{---}NH\text{---}CO\text{---}CH_2 \end{array}\right\rangle N,$$

a body to be further investigated, as likewise is an amido-acetyl-urea (hitherto unknown) isomeric with glucocyamine, amido-acetyl-urea—

$$NH_2\text{---}CO\text{---}NH\text{---}CO\text{---}CH_2\text{---}NH_2.$$

Glucocyamine—

$$\begin{array}{lll} CH_2\text{---}NH\text{---} & C = NH \\ \vert & \vert \\ CO\text{---}OH. & NH_2. \end{array}$$

Formation of the Acids of Sulphur.—J. Thomsen.—An exhaustive thermo-dynamic monograph.

Reduction of Mononitro-Napthoe Acid.—P. v. Rakowski.—After referring to the researches of Hofmann, Merz, Küchenmeister, and others, the author goes on to describe at length the preparation, first, of napthoe acid, and next of the mononitro compound thereof. The latter is further submitted to the action of metallic tin and hydrochloric acid, thereby yielding, after purification, a compound—

$$C_{22}H_{16}N_2O_2,$$

a crystalline compound, combining with neither acids nor bases, fusing at 174°, soluble, unaltered in strong sulphuric acid, and yielding, by the addition of water, another substance which has to be further investigated.

Observations on Hydrochinon and Substances related thereto.—O. Hesse.—Notwithstanding its high intrinsic merits, this essay, elucidated by very elaborate and complex formulæ, is not suited for abstraction.

Action of Potassium upon Benzol, and that of Bromethyl upon Naphthalin Potassium.—H. Abeljanz.—By heating absolutely pure and anhydrous benzol in a sealed tube with potassium to from 240° to 250°, a combination, by addition of the two bodies, is obtained; benzol potassium in a dry state, is a very explosive compound, which is also violently decomposed by water: when this decomposition takes place more slowly, under a layer of benzol, the result is the formation of diphenyl. The naphthalin potassium is violently acted upon by bromide of ethyl; among the products of this reaction is a hydrocarbon, $C_{20}H_{12}$.

History of the Azo Compounds.—S. Alexejeff.—The chief aim of this brief notice is to point out that several azo compounds, lately described in the *Berichte* and other scientific periodicals, have

been long since known and fully described in the Russian language, not only in monographs but also in publications issued in Russia, printed in either the French or German languages. The author quotes the titles and other particulars at length.

Nitro Compounds of the Fatty Series.—V. Meyer and A. Rilliet.—The third part of a monograph on this subject; this section treats on brom-nitroethan and normal nitro-propan.

Nitro Compounds of the Fatty Series.—V. Meyer and C. Chojnacki.—This fourth portion of the exhaustive monograph treats on pseudo nitro-propan, and contains an elaborate tabulated form, too lengthy for reproduction, exhibiting the reactions of sodium nitro-methan, sodium nitro-ethan, sodium nitro-propan (normal), sodium nitro-propan (pseudo), with mercuric chloride, ferric chloride, barium chloride, cupric sulphate, plumbic acetate, and argentic nitrate.

On Aromatic Amido Acids containing Alcohol Radicals.—P. Griess.—This memoir is termed a preliminary notice; it is divided into the following sections, copiously illustrated by a large number of complex formulæ—action of iodethyl upon amido benzoate of potassa; action of nitrous acid upon ethylamido benzoic acid; action of iodallyl upon amido benzoate of potassa; action of iod-methyl upon amidoanisic acid.

Isomorphism of the Anhydrous Sulphates of the Alkaline Earths.—A. Arzruni.—This paper treats on cœlestine (native sulphate of strontia) in a chemico-crystallographic point of view. The author analysed six varieties of this mineral as found near Lake Erie, at Rüdersdorf (near Berlin), in Sicily, near Bristol, near Mokkatam (Egypt), and Pschow (Russia); and all these minerals are found to be free from sulphate of baryta, but contain a small quantity of sulphate of lime. The method of analysis, decomposition of the cœlestine by means of a solution of carbonate of soda in sealed tubes placed horizontally in a water-bath, and kept there for at least 12 hours, is minutely described.

On Cyan-Carbonic Acid Allyl-Ether.—R. Wagner and B. Tollens.—This monograph is not well suited for abstraction, an observation applying also to the following essay:

On Dibenzyl-Dicarbonic Acid.—A. P. N. Franchimont.

An Ether of Pyrouvic Acid.—A. Oppenheim.—The rather cumbrous and difficult method of preparing this ether is described at great length. The ether, pyrouvate of methyl, is a fluid; boils at between 134° and 137°, sp. gr. at 0°=1·154, formula—

$$CH_3---CO---CO_2CH_3.$$

On Polymeric Modification of Isobutyl-aldehyde.—G. A. Barbaglia.—The para-isobutyl-aldehyde herein alluded to is a solid crystalline body; fusion-point, 59° to 60°; vapour density = 105·55; formula, $3C_4H_8O=C_{12}H_{24}O_3$.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3620. J. C. Ramsden, Lightcliffe, Halifax, and J. M. Tankard, Bradford, Yorkshire, "New and improved methods or processes of and apparatus for staining or dyeing fibrous filaments when in the raw or when in a partly prepared state.—Petition recorded December 2, 1872.

3687. R. S. Best, Goole, Yorkshire, "Improvements in the manufacture of phosphates of soda and potash and chloride of ammonium; also in the manufacture of chemical manures and alkalies."—Petition recorded December 5, 1872.

3692. M. Henry, Fleet Street, London, "Improvements in preserving and protecting ships' sheathing and other metal surfaces exposed to the action of sea-water."—A communication from M. L. Ehrmann, Boulevart Sainte Martin, Paris.

3696. T. Green, Ouseburn, Newcastle-on-Tyne, "Improvements in the treatment of bones and other articles, and in apparatus for the same."—Petitions recorded December 6, 1872.

3736. W. R. Lake, Southampton Buildings, London, "An improved insulating compound for telegraphic purposes."—A communication from Z. G. Simmons, Kenosha, Wisconsin, U.S.A.—Petition recorded December 9, 1872.

3755. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the treatment and utilisation of sewage water."

3763. R. S. Casson, Brierley Hill, Staffordshire, "Improvements in puddling furnaces, heating furnaces, and other reverberatory furnaces used in the munufacture of iron and steel."—A communication from P. A. Dormoy, Troyes, France.—Petitions recorded December 11, 1872.

3775. J. Hunt, Ewell, Surrey, "Improvements in the manufacture of gunpowder and in the apparatus employed therein."—Petition recorded December 12, 1872.

NOTICES TO PROCEED.

2337. T. Richardson, J. W. Richardson, and A. Spencer, West Hartlepool, Durham, "Improvements in the manufacture of iron and steel, and of revolving puddling furnaces or convertors, and apparatus to be employed therein."—Petition recorded August 6, 1872.

2351. G. M. Moore, Liverpool, "Improvements in the process of evaporating or concentrating alkaline liquors in the manufacture of caustic soda, caustic potash, soda-ash, and other similar substances; also for heating or boiling and refrigerating solutions in breweries, distilleries, chemical and other manufactories, and in the apparatus employed therefor."—Petition recorded August 7, 1872.

2446. A. R. Arrott, Saint Helens, Lancashire, "Improvements in the manufacture of carbonate of soda."—Petition recorded August 16, 1872.

2687. B. B. Standen, Blackheath, Kent, "Improvements in collecting and treating human excrement, both solid and liquid, and in the treatment of other animal urine, also in the means or apparatus employed therein."—Petition recorded September 11, 1872.

2711. W. D. Ruck, Greenwich, Kent, "Improvements in the manufacture of gas."—Petition recorded September 12, 1872.

2943. E. J. Payne, Packwood, Warwickshire, and W. Clarke, Dudley, Worcestershire, "Improvements in converting or partially converting iron into steel."—Petition recorded October 5, 1872.

3160. W. T. Cooper, Oxford Street, Middlesex, "Improvements in preparing or making up medicated and other effervescing mixtures."—Petition recorded October 24, 1872.

3642. C. W. Siemens, Great George Street, Westminster, "Improvements in smelting iron and steel, and in furnaces and apparatus employed in connection therewith, parts of which improvements are also applicable to regenerative gas-furnaces generally."—Petition recorded December 3, 1872.

PATENTS SEALED.

1845. W. Bull, Chancery Lane, Middlesex, "Improvements in making salt from brine."—Dated June 19, 1872.

1878. J. Tourre, Avignon, France, "Improvements in obtaining colourable matters derivable from madder, munjeet, and other allied roots."—Dated June 21, 1872.

1948. F. J. Cheesbrough, Liverpool, "Improvements in the process of manufacturing oil and oil-cake from seeds, and in the machinery to be used therein."—A communication from W. B. Fisher, Newark, New Jersey, U.S.A.—Dated June 27, 1872.

2717. W. S. Dixon, Grosvenor Place, Middlesex, "Improvements in the manufacture of plute iron or refined metal."—Dated September 13, 1872.

2988. J. Young, Kelly, Renfrewshire, N.B., "Improvements in treating liquors containing ammoniacal compounds in order to obtain products therefrom."—Dated October 10, 1872.

3094. E. C. Nicholson, Herne Hill, Surrey, "Improvements in the production of colours for dyeing and printing,"—Dated October 19, 1872.

NOTES AND QUERIES.

Sulphur Dioxide.—On page 126 of Roscoe's "Chemistry," the molecular weight of sulphur dioxide is given as 65. How is this got?—E. T.

Analysis of Sugars.—Would your readers kindly inform me the best book published that treats on the complete analysis of sugars?—Subscriber.

Mycoderma Vini and M. Aceti.—I shall be glad of a reference to where I shall find the fullest descriptions of Mycoderma Vini and Mycoderma Aceti, and of other organisms found in wines.—A. Z.

Acid in Crude Sugar.—Can any of your readers inform me what is the best way to determine the amount of acid in crude sugar when the percentage is very small? I have it to do frequently, and manage in this way, which is not always satisfactory:—A few grammes of sugar are weighed out, dissolved in water, tested with litmus paper, and the solution found to be distinctly acid. Normal soda is then added from a pipette divided into hundredths of a centimetre, and the solution tested by dipping in slips of litmus paper after the addition of one or two drops. This is somewhat clumsy, and probably not very accurate. Again, how is the acid to be reckoned, or rather as what? In making my reports I calculate it as acetic acid.—J. M. Merrick, Laboratory, 59, Broad Street, Boston, Mass., U.S.A.

Analysis of Hyposulphites, Sulphides, and Sulphites in the same Solution.—(Reply to "Alkali.")—Estimate the sulphides by means of an ammoniacal solution of zinc, using a drop of lead solution on filtering paper as an indicator. Add to another sample of the original solution some acetate of zinc (or chloride or sulphate of zinc, with a few drops of acetic acid), dilute to 300 c.c., pour through a dry filter, and save two portions of 100 c.c. of the clear filtrate. In one of these estimate the hyposulphites and sulphites together by iodine solution, in the other destroy all hyposulphite by boiling with dilute sulphuric acid, collect and weigh the sulphur,—either as such or after oxidation as barium sulphate,—and calculate the hyposulphites from it: the sulphites are found by subtraction from the last testing (with iodine). Test, as a check, the original solution direct by iodine solution (without removing the sulphides by zinc solution; the result might so agree with the sum of the single determinations made as above. Another method is this:—Estimate the sulphides by zinc, and the sum of the sulphites and hyposulphites as above; also the sulphates in the usual manner. Then oxidise all sulphur compounds to sulphates by heating the solution with potassium chlorate and hydrochloric acid, and estimate the sulphate now present. An easy calculation will show the amount of sulphur present in excess over what it would be if the iodine determination had only shown sulphites, and this excess corresponds to the hyposulphites. In both methods the polysulphides are estimated along with the monosulphides.—George Lunge.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 13th.—Royal Geographical, 8½.
—— Medical, 8.
TUESDAY, 14th.—Royal Institution, 3. Prof. Rutherford, "On the Forces and Motions of the Body."
—— Civil Engineers, 8.
—— Photographic, 8.
WEDNESDAY, 15th.—Meteorological, 7.
—— Society of Arts, 8. C. W. Vincent, F.C.S., "On the Sulphur Deposits of Kriswick, Iceland."
THURSDAY, 16th.—Royal, 8½
—— Chemical, 8. Mr. Grimshaw, "On Ethylamyl." C. Schorlemmer, "On Heptanes from Petroleum." S. Carnelley, "On Vanadates of Thallium." C. T. Kingzett, "On the Formation of Sodium Sulphide by the Action of Sulphuretted Hydrogen upon Sodium Chloride."
—— Royal Society Club, 6.
—— Royal Institution, 3. Dr. Debus, F.R.S., "On Oxidation."
FRIDAY, 17.—Royal Institution, 3. Wm. Spottiswoode, LL.D., "On the Old and New Laboratories at the Royal Institution."
SATURDAY, 18.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

THE CHEMICAL NEWS.

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ON THE

FORMATION OF SODIUM SULPHIDE BY THE ACTION OF SULPHURETTED HYDROGEN UPON SODIUM CHLORIDE AT HIGH TEMPERATURES.

By C. T. KINGZETT.

THAT sodium sulphide was so formed the author first found by the passage of coal-gas over sodium chloride at a red heat. Concluding that its formation depended upon the presence of sulphuretted hydrogen in the gas used, experiments were made in which pure sodium chloride was exposed to the action of washed and dry sulphuretted hydrogen, at various temperatures, for periods varying from ten minutes to three hours. Sodium sulphide was always formed in amount varying and equal to from 0·93 to 15 per cent of the sodium chloride used. The temperature most conducive to the formation of sodium sulphide was found to be one sufficient to thoroughly fuse the salt used; and the rate of the current of sulphuretted hydrogen must be rapid enough to carry off at once the hydrochloric acid set free. The sulphuretted hydrogen used was sometimes obtained by the passage of pure hydrogen over fused sulphur, but generally by the ordinary methods.

Other experiments showed that neither hydrogen nor sulphur produced sodium sulphide when transmitted over sodium chloride at a red heat. So that when it is formed by the action of sulphuretted hydrogen it must be the result of a direct reaction.

$$2NaCl + H_2S = Na_2S + 2HCl.$$

More experiments are in progress, to decide whether this is the only and ultimate reaction that takes place; but from examinations of the gaseous products, the author inclines to the belief that it is not.

ON A NEW METHOD OF VIEWING THE CHROMOSPHERE.*

By J. N. LOCKYER, F.R.S., and G. M. SEABROKE.

THE observations made by slitless spectroscopes during the eclipse of Dec. 11, 1871, led one of us early this year to the conclusion that the most convenient and labour-saving contrivance for the daily observation of the chromosphere would be to photograph daily the image of a ring-slit, which should be coincident with an image of the chromosphere itself.

The same idea has since occurred to another of us; we therefore beg leave to send in a joint communication to the Royal Society on the subject, showing the manner in which this kind of observation can be carried out, remarking that although the method still requires some instrumental details, which will make its working more perfect, images of the chromosphere, almost in its entirety, have already been seen on several days during the present month and the latter part of last month.

The image of the sun is focussed on a diaphragm, having a circular disk of brass (in the centre) of the same size as the sun's image, so that the sun's light is obstructed, and the chromospheric light is allowed to pass. The chromosphere is afterwards brought to a focus again at the position usually occupied by the slit of the spectroscope; and in the eye-piece is seen the chromosphere in circles corresponding to the "C" or other lines. A lens is used to reduce the size of the sun's image, and keep it of the same size as the diaphragm at different times of the year; other lenses are used in order to reduce the size of the annulus of light to about $\frac{1}{8}$ inch, so that the pencils of light from either side of the annulus may not be too divergent to pass through the prisms at the same time, and that the whole annulus may be seen at once. There are mechanical difficulties in producing a perfect annulus of the required size, so one $\frac{1}{2}$-inch diameter is used, and can be reduced virtually to any size at pleasure.

The proposed photographic arrangements are as follows:—

A large Steinheil spectroscope is used, its usual slit being replaced by the ring one.

A solar beam is thrown along the axis of the collimator by a heliostat, and the sun's image is focussed on the ring-slit by a $3\frac{3}{4}$-inch object-glass, the solar image being made to fit the slit by a suitable lens.

By this method the image of the chromosphere received on the photographic plate can be obtained of a convenient size, as a telescope of any dimensions may be used for focussing the parallel beam which passes through the prisms on to the plate.

The size of the image of the chromosphere obtained by the method adopted will be seen from the accompanying photograph, taken when the ring-slit was illuminated with the vapours of copper and cadmium.

* A paper read before the Royal Society.

ON THE SUPPLY OF PIG-IRON FOR THE BESSEMER PROCESS.*

By W. BAKER, Associate of Royal School of Mines.

THE Bessemer process has exercised so important an influence upon the iron and steel manufactures of England, and is such a bold innovation upon the ordinary metallurgical processes, that I may fairly assume a short paper upon its present condition will not be inappropriate for the discussion of the Rotherham Literary and Scientific Society. The opportunity of bringing out our thoughts upon some special subjects with which each of us may be familiar is a peculiar advantage of such meetings as the present. Without pretending to be teachers, or to speak with an authority not to be questioned, we may at least give a direction to other minds, which may result in not only the confirmation and strengthening of our own ideas, but also in some determinate action.

The Bessemer process, as you know, consists in forcing jets of atmospheric air through molten pig-iron, whereby certain combustible elements which are found in pig-iron are burned. The fuel thus made use of in the iron itself developes an intense heat, and all who have witnessed a Bessemer "blow" will agree that it is one of the grandest sights of our manufacturing neighbourhood. According to Hunt's Mineral Statistics in 1869, there were 57 Bessemer converters, with an aggregate capacity of 248 tons. The last return for 1871 give 89 converters, with a potentiality of 446 tons. Taking 5 charges a day, or 30 charges a week, this gives us 669,000 tons per annum, against 372,000 tons in the year 1869. It will be readily conceived that this enormous increase has had its effect upon the supply of the raw material. Let me then place together the figures denoting the production of pig-iron for the same years. In 1869, pig-iron, 4,970,206 tons; 1871, ditto, 6,627,179 tons: an increase of 33 per cent. Now, the question arises, how much of this pig-iron is used actually, and how much can be used for the Bessemer process? The quotation in the market price lists of Bessemer pig disclose the fact that there is a special quality of iron

* A Paper read before the Rotherham Literary and Scientific Society.

suitable for this manufacture. In order to appreciate accurately this fact, I will dwell for a few moments upon the chemical reactions which take place in the conversion of pig-iron into Bessemer steel. Ordinary pig-iron may contain carbon, silicon, manganese, sulphur, and phosphorus; traces of other elements are sometimes found. For the Bessemer process, as well as for crucible cast-steel, the absence of sulphur and phosphorus is essential, or at most they may be present in extremely small quantities. Now, in the Bessemer converter, silicon appears to have the greatest affinity for the oxygen of the air. That is to say, silicon burns first and produces the heat due to its chemical combination with oxygen. The product of combustion is in its pure state a white solid, infusible, except under the oxyhydrogen blowpipe. In the converter it combines with some oxide of iron, and forms the slag or cinder, but often balls of white pumice-like silica, covered with a thin case of iron silicate, may be picked out of the cinder. These seem to have been formed by the rolling or splashing of the iron over the silica as it aggregated upon the surface of the molten metal. During the combustion of the silicon a more intimate combination takes place between the iron and the carbon. That is to say, the grey pig-iron, in which flakes of graphite exist, crystallised out in the mass of the soft iron, becomes changed into what is known as white iron. The latter is a variety of pig-iron, in which the carbon is chemically combined with the iron. Spiegeleisen is a typical example of this kind of iron. And now the combustion of the carbon begins, the product of combustion being in this case a gas, and the blue flame of carbonic oxide becomes whiter, and the roar of the furnace increases to its maximum. If we suppose the blast to be continued beyond the combustion of the carbon, what would take place? The iron would burn; and often a brown smoke, which issues from the mouth of the converter at the end of the process, announces that this is actually the case. The metal also would become unmanageable by frothing. It is usual, therefore, to stop the blast when the flame drops, and to add a known quantity of spiegeleisen. This iron contains generally about five per cent. of carbon and nine to thirteen per cent of manganese. With this addition the charge is tranquillised, metallic manganese imparts fluidity to the metal, and seems to protect the carbon from being burned. This I conclude from the fact that the Bessemer ingots themselves only contain traces of manganese, whilst the carbon ranges about 0·5 per cent.

A word about sulphur and phosphorus. It seems that both these elements refuse to give up their combination with iron at the solicitation of torrents of oxygen, as it exists in the air at the high temperature of the Bessemer converter, although both sulphide and phosphide of iron may be roasted at a low red heat, and these elements be nearly entirely removed from the oxide of iron which is left. The problem of eliminating phosphorus from metallic iron, leaving the iron in the metallic state, is one of the most pressing problems for solution by the metallurgical chemist. Most of the metals which are used in the arts are obtained first accompanied by certain impurities, and a general mode of refining them is to re-melt them with an oxidising flame, with or without the addition of fluxes. Copper is thus treated, so is lead, and it is instructive to compare the results with those obtained with iron. Copper, when melted under the circumstances mentioned, affords a slag, rich in fusible red oxide of copper, which is itself a flux, and melts readily with the oxides of other metals which may exist as impurities—only gold and silver of the ordinary metals will remain unoxidised. Now let us consider the refining of lead by a similar process. The same removal of impurities takes place, but besides gold and silver we have a certain proportion of copper which refuses to be oxidised, but rather concentrates in the metal if the process is continued. Plainly other chemical reactions must be sought for its removal, and I am pleased to observe that my own labours in this direction have been acknowledged by Dr. Percy in his third volume, which treats of lead. The successful solution of the problem in this case was afforded by the property of copper alloying with zinc, which alloy forms a less fusible mass, that can be removed from the surface of the metal in which it floats. If we treat iron in a similar manner, we get a slag or cinder composed of oxide of iron and silica. The process I am considering is the puddling process, which in the first stage may be looked upon as an analogous refining process. The silicon oxidises first, then the carbon, and if we would keep the decarburised iron fluid, it is quite possible that at the expense of some of it the comparatively small amount of sulphur and phosphorus which makes the grand distinction between good and bad pig-iron might yet be eliminated. We are, however, stopped in the process of refining, *i.e.*, the removal of impurities by oxidation—by the infusibility of iron deprived of carbon, and the charge is balled up and taken to the hammer for the production of wrought-iron. What I wish to point out here is that phosphorus in iron is analogous to the copper in lead; both resist oxidation to the last. The Bessemer process affords no help, the higher temperature at least might give the opportunity for the experiment. I mean that it would be worth while to see whether by continuing the blast at the expense of the iron as fuel a proportion of phosphorus to the extent of, say one-tenth per cent in the original pig-iron might not be eliminated. If this fail, we can at once and for ever give up the oxidation process for the removal of phosphorus. In puddling, it is true, a certain amount is removed, and the able paper on the Danks furnace, by my friend Mr. Snelus, of the Royal School of Mines, points to the probability, if not to the fact, that phosphorus in iron is oxidised by pure oxide of iron at the temperature of the puddling furnace. This certainly suggests the injection of metallic oxides with the blast, although the fatal infusibility of the decarburised iron is not favourable to the experiment. Mr. Isaac Lowthian Bell, whose labours as a scientific manufacturer cannot be too highly commended, has made some significant remarks on this subject. He says, "The limit to the production of Bessemer pig is the want of ores free from phosphorus." This may be correct, and so firm may be the grip that phosphorus holds on iron, that breaking up the bonds that bind them together may defy the skill of our scientific men; but it may be well to remember that the yearly make of iron from Cleveland stone alone contains about 30,000 tons of phosphorus, worth for agricultural purposes, were it in manure as phosphoric acid, above a quarter of a million, and that the money value difference between Cleveland and hematite iron is not short of four millions sterling, chiefly due to the presence of this £250,000 worth of phosphorus. The Pattinson process does not leave one part of silver in 100,000 of lead, the Bessemer converter robs iron of almost every contamination except phosphorus, but nine-tenths of this ingredient is expelled by the puddling furnace. It may be difficult, but let it not be supposed there would be any surprise excited in the minds of chemists if a simple and inexpensive process for separating iron and phosphorus were made known to-morrow, so that only one of the latter were found in 5,000 of the former. Analyses of the best Bessemer pigs give the following amounts of phosphorus, viz.:—0·014, 0·01, and 0·016 per cent. I select from analysis of Bessemer steel the following:—English make: 0·025, 0·033, 9·032, 0·026; mean, 0·029 per cent. of phosphorus. German make: 0·132, 0·134, 0·093, 0·041; mean, 0·10 per cent. of phosphorus. It will be noticed from the foregoing quotation that Cleveland pig-iron is contrasted with hematite iron. The distinction is this. Hematite iron produced from an ore of iron called hematite is sufficiently free from phosphorus to produce an iron suitable for the Bessemer process. Cleveland iron may contain from 0·5 to 1·5 per cent of this element.

The important question which justifies the title of my paper is this—What iron ore and how much iron is

there available to produce iron as good as this hematite iron? The total amount of iron ore produced in the United Kingdom is 16,334,888 tons. Of this large amount about one-eighth is hematite. The chief ores of iron, specimens of which are on the table, are as follows:—

Hematite, or red oxide of iron, in its purest state, contains 70 per cent of metallic iron. This occurs in the carboniferous limestone in Cumberland and North Lancashire. These deposits contain only traces of sulphur and phosphorus, or none at all. In 1871 2,232,068 tons were raised. Hematites are also found in Cornwall. The produce of this county is given at 9154 tons in Hunt's Mineral Statistics, but it is believed a much larger sum may be realised. Somersetshire afforded 2654 tons. Here our supply of magnificent ore comes to an end.

The next ore in importance is the brown iron ore called *Brown Hematite*. In composition this ore is oxide of iron combined with water. Some of the finest specimens are from the Forest of Dean, Gloucestershire. The Spanish and Portuguese ores seem to contain less combined water, and to hold a place between the ordinary brown hematites and the red ore.

Spathic or spathose iron ore is carbonate of iron. It is found in the Devonian series of rocks. This ore is renowned for producing the spiegeleisen in Saxony, which is imported for use in the Bessemer process. Somersetshire affords 27,556 tons, Northumberland and Durham 88,449 tons. I may observe here that spiegeleisen is another matter which presses itself upon the attention of the manufacturer of Bessemer metal. Until lately we were entirely dependent upon foreign countries, Germany or Sweden, for this beautiful pig-iron. But two years ago the Ebbw Vale Company succeeded in producing it. It is believed that the spathose ore is essential to its production, but I think as we have now interpreted in a scientific manner the old fashioned dogma about the nature of the ore giving a certain nature to the iron, it is quite possible to produce spiegeleisen from other ores than spathose. In this direction, if I may be allowed to speak critically, I think our local manufacturers have not shown sufficient enterprise.

Magnetic iron ore is a dense black ore. It is the real loadstone, but little developed in this country. The Swedes here have the advantage. It is nearly always very free from the objectionable impurities of sulphur and phosphorus, and if the find of coal in Sweden justifies the expectations of some of our speculators, good times are coming for the ironmasters in Sweden.

Micaceous iron ore is brought to this country from Elba, where it has been worked from the time of the Romans. This ore in composition is exactly that of red hematite. By far the larger proportion of iron ores in this country is the kind known as argillaceous carbonates—the clay iron ores of the coal measures. These we must dismiss from the category of ores fit for producing Bessemer pig. The proportion of phosphoric acid they contain varying from 0·3 to 0·7 per cent. The same may be said of the hydrated oxides of Lincolnshire, Northampton, and other places, as well as the argillaceous carbonates of the Cleveland district. The latter contains 1·07, 1·86, 1·17 per cent of phosphoric acid. Wellingborough ore contains 1·26 per cent of phosphoric acid. From Scotland we have little hope of ore suitable for Bessemer pig. Ireland may furnish a little. Even now Antrim affords a valuable aluminous ore which is said to be free from phosphorus. It will be seen, therefore, that until phosphorus can be eliminated from pig-iron, or until these ores which lie in such vast quantities at our feet can be smelted, so as to keep the phosphorus out of the iron, we must look to foreign ores for a supply of Bessemer pig. In Sweden, according to Forbes, there are 800 square miles producing magnetic iron ore, or specular oxides containing from 40 to 68 per cent of metallic iron, without any trace of sulphur and phosphorus, upon a convenient line of railway. It is estimated that ore of about 60 per cent could be delivered in England at 25s. per ton. The Spanish and Portuguese ores would no doubt produce a pure iron, and it remains to be seen how much the production of Bessemer pig will be increased by their use. That pure ores are greatly in demand may be judged from the fact that not only from Elba, but also from Algeria and Turkey iron ores are being sent into this country. Out of 16 million tons only two million of our iron ore is available for Bessemer pig, producing about 700,000 tons of Bessemer metal.

In conclusion, I must deprecate any severe criticism on my figures. The general facts, I think, I have placed fairly before you. It would have been impossible, without much greater labour and more time for inquiry, to get accurately the quantity of iron ore really used for producing Bessemer pig. At least I have drawn attention to the necessity of augmenting its source in a town where such a manufacture cannot but be regarded with unusual interest.

ON THE UTILISATION OF WASTE COAL.

By Dr. W. H. WAHL,
Secretary of the Franklin Institute.

The desirability of effecting the economic utilisation of the coal waste daily accumulating in the anthracite-mining regions is universally conceded. This waste, to take a moderate estimate, is not far from 50 per cent of the total production. The question has for years attracted the attention of inventors, of those interested in the mining and transportation of coal, and others, the result being the announcement and testing, from time to time, of a number of plans for satisfactorily attaining this object. It is, however, only within the past few years that the growing importance of the problem has attracted general public attention to the attempts at its realisation. With every expansion of the industries dependent upon coal for their existence, and therefore highly sensitive to the price of this commodity, the necessity for its successful solution will be enhanced. Thus far, however, it may be safely asserted, no process has been devised for this purpose which could be operated with a reasonable amount of success—a declaration which is verified by the fact that, after a trial of a few months, each has invariably been abandoned, though it is very probable that there are some among the hundred odd patents granted in this country alone under this heading which, under the stimulus that would be afforded their owners by any considerable increase in the marketable value of coal, would prove to be of practical value.

The difficulties in the way of effecting the utilisation of the anthracite waste are very great. They involve not only the question of economy of manufacture, which is absolutely controlled by the ruling price of coal at the mines, and which, from a financial standpoint, must necessarily stamp any such plan with a speculative character, but they reside also in the chemical and physical nature of the material.

The processes for the utilisation of the anthracite waste consist universally in the employment of a foreign material or materials, which shall serve the purpose of a cement to bind the loose particles of the waste together. The cements heretofore used have been both of mineral (incombustible) and of organic (combustible) character. In the majority of instances, as is usually the case with a field of invention just ripening into importance, the patentees of such processes display a characteristic ignorance of, or lofty indifference to, the conditions of the problem they profess to solve. The number and variety of substances which have been secured by inventors, either as cements, or to aid in the cementation or combustion, is well calculated to surprise one unfamiliar with the literature—if such an expression is allowable when applied to patent office records—of the subject. The several alkaline substances and their

silicates seem to have been held in special favour, since they repeat themselves, with some modifications, in several places. Lime, either alone, or with some subsequent chemical alteration into carbonate, sulphate, or sillicate is claimed; or plaster-of-paris or hydraulic cement are used directly. Clay must also be named. Among organic substances may be named pitch, coal-tar, resin, the Trinidad bitumens, asphalt, petroleum residues, dextrine, glue, Grahamite, &c., while as accessories, employed either to assist cementation or combustion, we have sawdust, chaff, flour, blood, cow-dung, starch, sand, saltpetre, and other substances too numerous to mention. Comparatively few of these processes have ever reached a public trial, as indeed few deserve it, and of those which have received attention, none have been more than indifferently successful, either from inherent deficiencies or from commercial reasons. We give a brief survey of some of the more important processes.

For a number of years the bituminous or semi-bituminous waste from the mines of Germany, France, and Belgium, has been to a considerable extent successfully utilised by mixing with it from 15 to 30 per cent of ordinary moist clay, and pressing this plastic mass into forms of any desired shape and size. The product thus obtained, though of inferior heating quality, still secures a ready market, owing to the high price of coal in the countries named, where it finds employment not only for household purposes but also for steam generation. Quite recently a similar process, by which the percentage of cementing clay is reduced to a minimum, has been brought out in America by a Belgian engineer familiar with the methods employed abroad. His plan, according to description, is to employ about 7 per cent of clay with the dust, and, after thoroughly mixing the materials, to bring the mixture into a pressing machine, where it is pressed into cylindrical forms of convenient size under considerable pressure. In order to protect the product from the disintegrating effects of rain or dampness, the inventor passes the lumps thus formed through a bath of resin dissolved in benzine, obtaining in this way thin hide of resin upon the surface of the lumps, which effectually serves the purpose of excluding the water.

This plan, from its simplicity, aided doubtless by the favourable opinion expressed of its merits by a committee of the Franklin Institute, has received the favourable consideration of the Lehigh Coal and Navigation Company. The adandoned works of a former unsuccessful company, which will be named hereafter, situated at Nesquehoning, Carbon County, Pa., have lately been secured by the Lehigh Company, for the purpose of giving the plan a thorough trial. The expensive machinery of their predecessors has been, or is now, in process of being modified to suit the present plan.

The same inventor has laboured zealously in this field for a number of years in the South, having for some time successfully manufactured at Nashville, Tenn., an artificial fuel by the same general process from the Southern bituminous coals, until certain business complications conspired to raise the price of the waste to so high a figure that the manufacture was abandoned.

The other plans (employing a mineral cement) as yet made public include those using an alkaline silicate (water-glass), either alone or in connection with a chloride of calcium or magnesium, or both, an hydraulic cement, plaster-of-Paris, &c. As far as the knowledge of the writer extends, none of these have yet passed through the ordeal of practice, and should this have occurred with any one of them it has simply resulted in a failure. All such attempts must prove unsuccessful, from the fact that either the combustible character of the coal waste is so considerably reduced by the mixture with it of from 10 to 20 per cent of non-combustible materials that the product can only be burned with difficulty, necessitating either constant attention or an artificial draught, or the cement employed fuses in the heat of the furnace, and, coating the cemented particles with a liquid glass, prevents the access of the air to it, preventing its combustion, and, finally, forms an objectionable clinker. For reasons to be specified below, the writer is of the opinion that no process employing a mineral cement will ever be more than indifferently successful, not excepting the clay process, of which so much is anticipated.

It is well known that coal of any description, and especially when in the finely-comminuted condition of dust, if exposed for some time to the combined action of air and moisture, gradually deteriorates in heating quality. This deterioration is produced, first, mechanically, by the slow admixture with it of dust and dirt carried by the winds; and, secondly, by a slow process of oxidation, analogous to the rusting of iron, which infallibly attends the exposure of any readily oxidisable substance to atmospheric influence. From both of these causes, the heating quality of the coal waste is slowly reduced (or its percentage of ash, to state the case in other words, is slowly increased), and this reduction in quality grows greater and greater with the time of its exposure. With bituminous lump, Varrentrapp estimates, from careful experiments, that the loss of heating power, from chemical causes alone, may even reach 25 per cent, and, for purposes of gas production, 45 per cent. With anthracite lump, the deterioration from this cause alone will be far less than with bituminous; but, from both the causes named, it must be evident that, with the anthracite in form of waste, the deterioration must in most cases be considerable enough to gravely influence the success of any plan having in view its manufacture into artificial fuel. By the employment of dust from freshly mined coal, or of a judicious mixture of the old waste with the new, the difficulty from this source may be partially overcome; but no scheme having for its object the utilisation on a large scale of the vast waste heaps of the anthracite region, can afford to be blind to the objection here named, since it is mainly from more or less deteriorated materials that the product to be utilised must be obtained.

Instead, therefore, of employing in the cementation of the waste a substance incombustible in itself, and which directly adds so much to the percentage of ash, and still further detracts from the heating quality of the waste, the path seems pointed out to inventors to seek about for some cementing material which, being itself combustible, will improve the heating qualities of the poor waste, and which must be free from certain collateral objectionable features incident to the problem. This fact seems to have been recognised long ago, as the list of combustible cements given previously would indicate. Whatever of historical record there has come to our knowledge with regard to their trials, however, is equally unfortunate with the mineral cement processes. In some of the European countries only, have the attempts to employ coal-tar, pitch, resin, and kindred substances to bind the loose particles of dust into a coherent mass been successful. In America it has several times been essayed to apply such a process to the utilisation of anthracite waste, but all have signally failed.

Several years ago a company was formed with this object in view, by whom the extensive works at Nesquehoning, Carbon County, Pa., referred to in a former portion of this article, were erected. They employed a mixture of waste anthracite with coal-tar; this, after the most thorough mixture which could be attained (with the aid of heat), was pressed into suitable forms, and subsequently transferred to an oven, in which it was subjected to a baking process. From the testimony of several engineers, superintendents, and others who used it, it appears that the product, in spite of the increment given to its heating quality by the addition of coal-tar, was but an inferior steam generator. Whether the only partial carbonisation of the tar by the baking process allowed the offensive coal-tar odour to be perceived or not, is a contingency not known to us; but it will readily be granted that, unless this carbonisation was complete, the introduction of the product for the household was im-

possible from the outset. It is most probable that the complicated character of the process, and the number of details requiring personal attention of workmen, aside from any consideration of the quality of the product, rendered the expense of its manufacture too great to permit of a successful competition with coal, and contributed mainly to the abandonment of the enterprise, which shortly followed. The failure of this, the best organised effort of any yet made to solve the problem of the waste heaps, would seem to indicate that, though similar plans have been, and are still, in successful operation in continental Europe, the cost of mining coal with us is yet too low to permit of the employment of a tarry or resinous cement to utilise our anthracite waste, even admitting that the fuel produced were of a satisfactory quality.

Of the other patented processes, but few are worthy of mention; the great majority read too much like kitchen recipes to deserve serious consideration, as a glance at the list will show.

It is of interest to note that the first reasonable process to utilise this material originated with Mr. Bessemer, in England, where the demand for some such process will be more than ever urgent, now that the English coals have lately risen so considerably in price. Mr. Bessemer's process is for the manufacture of an artificial fuel from bituminous waste, by employing a peculiarly constructed furnace, having a device somewhat like an endless chain-pump arranged horizontally, upon the successive sections of which the bituminous material, without foreign admixture, is led in from a hopper above, and is taken continuously from the furnace in a semi-caked plastic condition, and pressed in suitable forms or moulds, which are then ready for use. This plan has received considerable praise from scientific critics, of which it is indeed well worthy. It is now stated to be in successful operation in several large manufactories in England.

There remain, finally, to be mentioned several American processes for utilising coal waste by the use of Grahamite as a cement, which, as far as a judgment of their merits may be formed without the crucial test of practice, may ultimately prove to be satisfactory.

With us, however, for the present, this field of industry lies fallow for want of a cultivator.—*American Gas-Light Journal.*

OUTLINE OF A NEW EXPLANATION OF THE ACTION OF SUNLIGHT ON IODIDE OF SILVER.*

By Dr. J. EMERSON REYNOLDS,
Professor of Analytical Chemistry, and Keeper of the Mineral Department in the Royal Dublin Society.

White light is known to exert a very marked influence upon a very large number of chemical substances; but certain salts of silver are known to be specially subject to the action of the more refrangible rays of the spectrum. When light acts for a considerable time on iodide, bromide, or chloride of silver, evident *decomposition* occurs; but when the action is stopped before any sensible effect has been produced, the silver salt can be shown to have suffered profound change, in consequence of which its relations to chemical agents are almost wholly altered. All who have practised the beautiful and interesting art-science of photography well know that advantage is taken of this subtle action of light in the familiar operation of "taking a negative." A layer of iodide of silver (or of iodide, bromide, and nitrate of silver) is exposed for a short time in a camera to an image formed by a lens; the silver layer, on removal, is apparently in the same condition after as before exposure; but when an acidulated solution of ferrous sulphate is applied, the parts which have been exposed to the action of light become dark, while the other portions of the film are unaffected. The iron solution is then said to "develop" the "latent image."

Notwithstanding numerous and well-directed investigations, the nature of this "latent image" remains a mystery. Quite recently, however, some remarkable experiments upon the action of light on chlorine have been published by Dr. Budde, of Bonn, which appear to me to give a very distinct clue to the *modus operandi* of light, more particularly on the iodide of silver.

I propose now to lay before the Society, in the first instance, a brief account of Dr. Budde's experiments, and his conclusions, and then to state the explanation of the nature and relations of the "latent image" on iodide of silver, which I have ventured to build upon the work of the German physicist.

It has been long well known that the blue and violet rays of solar light can determine the union of chlorine and hydrogen gases. The two bodies are freely miscible in the dark, without any chemical action taking place; but in diffused daylight the two gases slowly combine, and produce hydrochloric acid. If the mixture be exposed to direct sunlight, the same effect is obtained instantaneously, and a violent explosion is the consequence. The cause of this union under these conditions has not hitherto been traced out; but Dr. Budde has obtained the following remarkable evidence of the direct action of blue and violet light on pure chlorine gas:—

A quantity of chlorine gas was passed into a tube closed at one end, the gas being confined by a column of oil of vitriol saturated with chlorine, and the operation, of course, conducted as nearly as possible in the dark. A prismatic spectrum was formed in the usual way by means of a prism, and the several coloured rays, from red to ultra violet, allowed to fall in succession on the tube containing the chlorine, the latter being fixed in such a position that any alteration in volume which might take place during the experiment could be at once detected and estimated with the aid of an observing telescope, placed at a suitable distance. The red rays were allowed first to fall on the tube, but the effect produced was comparatively slight, as the maximum increase in the length of the gas column did not exceed the $\frac{1}{32}$th of an inch. The permanent expansion was greater in the more refrangible rays, until the maximum effect was obtained in the violet rays, the expansion being at least ten times greater than in the red rays, and this increase in volume was permanent. If the alteration of volume were caused by heat, the expansion should be temporary, and, further, the effect ought to be much greater in the red than in the violet rays. It is evident that the observed expansion *might* have been due to the decomposition of the sulphuric acid by the chlorine; but this source of error seems to have been fairly eliminated by substituting for the sulphuric acid saturated with chlorine the tetrachloride of carbon. The same result was obtained with the latter as with the former liquid.

If the experiments are to be fully trusted, chlorine is proved to have its volume permanently increased by exposure to the violet rays.

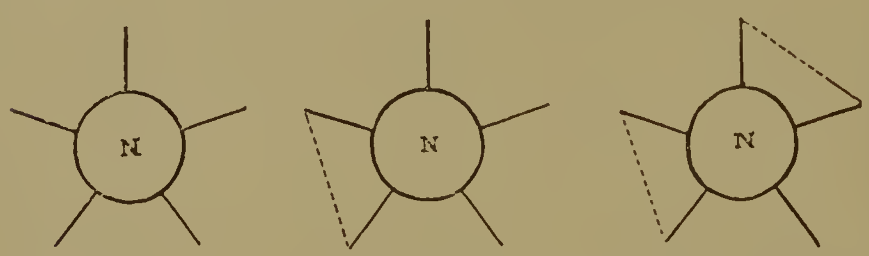
Dr. Budde concludes, from the results of his experiments, that sunlight, or rather the violet rays, act by decomposing the molecules of the chlorine, setting free the component atoms of which the so-called "molecule" is supposed to be built up. The atoms must occupy a greater space when separate than when combined forming the molecule, and are also in a peculiarly favourable condition for entering into combination with those of a new body. The rapid combination of chlorine and hydrogen under the influence of sunlight is, therefore, no longer difficult of explanation.

If Dr. Budde's conclusion be accepted for chlorine, it clearly follows that all the cases known to photographers, in which light brings about chemical change, may be explained simply and naturally on the hypothesis of the partial or complete separation of the atoms of which the molecule of a given compound may be built up. We here seem to break new ground, and to get a clue to a soun

* Communicated by the Author, having been read before the Royal Dublin Society.

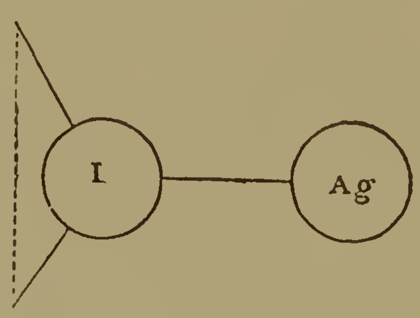
theory of the latent image, which shall serve to explain the phenomena relied on by the supporters respectively of the present vibratory and chemical hypotheses. I would now venture to suggest an explanation of the action of light on iodide of silver which, *prima facie*, seems to be complete.

It is well known that the atom of a chemical element is a sharply-defined relative quantity, but that the atoms of unlike matter often differ materially in the amount of chemical work they can perform; thus an atom of sulphur can represent 6 atoms of hydrogen in combination; nitrogen 5; carbon 4; boron 3; and oxygen 2 atoms of hydrogen; silver, on the contrary, only 1. But this so-called "equivalence" of an element is not absolutely fixed, for, in some of its compounds, nitrogen represents only 3 atoms of hydrogen—in ammonia, for instance—and in others, as in nitrous oxide, but 1. This variation is now commonly accounted for by supposing that pairs of points of attraction on the atom of a polyequivalent element disappear by neutralising each other, and thus lie hidden in certain forms of combination. If we represent the atom of nitrogen by a circle, its pentequivalent, triequivalent, and monequivalent conditions may be thus shown:—



In Nitric Acid. In Ammonia. In Nitrous Oxide.

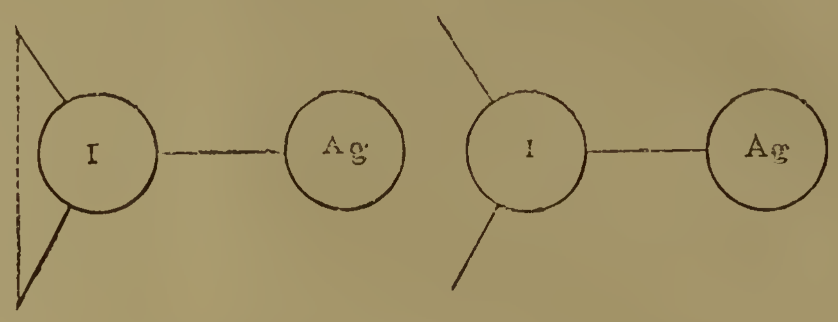
These points of attraction are now usually termed "bonds." Iodide of silver consists of 1 atom of silver and 1 of iodine, Now, the atom of silver is known to be equivalent to only 1 atom of hydrogen; but the study of organic and other iodine compounds teaches us that the atom of iodine is equivalent to 3 of hydrogen, though in most compounds only appearing to be equivalent to 1 hydrogen atom. Representing graphically the atoms of silver and of iodine respectively by equal circles, and the equivalence of each atom by lines projecting from the circumference as usual now in graphic formulæ, we may represent ordinary iodide of silver in the following way:—



Here one of the three "bonds" or centres of attraction of iodine is united with the single bond of silver, the other two neutralising each other, as indicated by the dotted line, and so remaining latent. Up to this point I have advanced nothing new; but it is necessary to recognise these preliminary matters in accounting for the action of light on iodide of silver.

Common experience leads us to the conclusion that in many cases the action of light chiefly consists in the severance of the union of unlike bodies held in combination by comparatively feeble affinity; and the highly interesting investigations of Dr. Budde would seem to go farther, and to prove that the same kind of action is inimical to the exercise of the still more feeble attractive force which tends to unite the atoms of like matter in molecules. We have only to extend the statement to the union of bonds in a single atom—as in the case of iodine—and we gain a perfectly intelligible conception of the nature of the influence exerted upon iodide of silver by light, and the cause of the well-known difference in chemical relations between the unexposed and exposed silver compound.

The two conditions may be graphically represented thus:—



Unexposed. After exposure.

After, as before, exposure the compound is iodide of silver; but two of the three attractive powers of the iodine are now free from each other's control, and ready to enter into new combinations. It is evident that change may now take place in either of two directions. First, the atom of iodide of silver may attract two additional atoms of silver or other analogous body to itself in so-called development; or, secondly, a complete separation of iodine from silver may arise, owing to the exercise of the superior power of the two free bonds of the former over the one attached to the silver atom. It appears by no means improbable that the first condition obtains in acid development with excess of silver, while in alkaline developement the action is more likely to be chiefly of the second kind.

Up to the point at which it is necessary to assume that light is capable of severing the union between the latent "bonds" of iodine, the theory is in harmony with the current of thought in chemistry. But it is not yet generally admitted that a "bond" can remain free or unsatisfied. The existence of such apparently anomalous compounds as nitric oxide and certain of the chlorine oxides has, however, led some chemists to think that certain "atomicities" in a compound may remain free, and ready to enter into new combinations on a favourable opportunity presenting itself. The experiments of Dr. Budde on chlorine strongly support such a view; and, further, when we carefully consider the action of chlorine on olefiant gas, under the influence of sunlight, I see no difficulty in supposing light actually to have the power of severing the union between the latent "bonds" of an atom. I venture to think that this could take place even more easily in some cases than could the separation between the atoms of the molecule of a simple body, or—the much more difficult case—of the disunion of the unlike atoms of a compound such as iodide of silver. If, then, the last, and as must be admitted, the least likely case to occur is that which we can, in several compounds, actually observe, we are clearly warranted in assuming the much easier, and, *a priori*, the more probable, change to take place also.

Let us now apply the theory stated above to the explanation of some of the facts of development. I shall take at present only the case of acid development—with iron, for example—in the presence of excess of silver in the solution flooding the film. The acid present prevents the immediate deposition of metal; but still the exercise of even a very slight attractive power is capable of separating the silver from the liquid. The existence and exercise of the surplus chemical energy of the iodine atom of the exposed iodide of silver is amply sufficient to account for the attraction to the exposed iodide only of the metal silver, and this without assuming that the iodide of silver itself suffers any decomposition; in fact, the process appears to consist in the formation of a *sub-iodide* of silver by *addition* of silver to the exposed iodide, not by *abstraction* of iodine, as might be supposed. If such a definite compound be produced in the manner indicated, its formula most probably is Ag_3I, for each of the three

"bonds" of the iodine is now engaged with an atom of silver.

If the film be now fully washed alter development, we have a layer of ordinary iodide of silver carrying an image formed of a sub-iodide of silver the constituents of which are held together by comparatively feeble force; but it is by no means improbable that the determination of silver to the exposed iodide in the first instance, in order that the sub-iodide may be formed, facilitates the deposition at the same time and on the same part of the film of metallic silver in addition; so that we are not to look upon the image as consisting only of the sub-iodide, but as carrying some free silver also.

When the conditions of development are such as to admit of very rapid deposition of this so-called "supplementary" silver, we should expect the precipitation to be determined by that species of sympathy so often observed in chemical processes, acting even outside the sphere of attraction of the exposed iodide of silver, and thus give rise to the well-known phenomena of solarisation and of fog. Assuming the image to be free from these defects, however, its subsequent intensification results from the well-known attraction of silver for silver on the point of deposition from solution.

Fixation by hyposulphite of sodium, or similar agent, in my view of the matter, consists in the decomposition of the above-mentioned sub-iodide of silver, ordinary iodide of silver dissolving, and the excess of silver remaining, and forming the image in its final condition.

Such is the view which I venture to take of the action of light on iodide of silver, so far as the production of the "latent image" is concerned. The most reliable experiments have proved perfectly pure iodide of silver to be sensitive to light; it is, therefore unnecessary for me to extend this paper beyond reasonable limits by discussing the details of photographic processes, in which iodide of silver plays the chief part; but I should add that, so far as I am aware, there are no facts which the theory just proposed is not capable of simply explaining. Further, when the apparently conflicting statements of the physical and chemical schools of thinkers on this subject are reconciled on the physico-chemical theory which I have advanced, we may fairly regard the latter as a safe aid to investigation. I have only to add that the above sketch of a new theory of the "latent image" is to a large extent derived from several detailed articles which I published in the last volume of the *British Journal of Photography*.

ON THE CHEMICAL PROCESSES OF THE LIVING PLANTS.

By A. EMMERLING

The chemical processes which obtain in plants are very imperfectly known to us. It is true that we are acquainted with a series of relations existing between some of the products of the materials of the vital activity of plants—for instance, that between chlorophyl and starch—and the manifold relations of some of the organic matters formed in plants to some of their mineral constituents, as for example the relation existing between potassa and starch, as proved by the researches of Nobbe. I must not also omit to notice the fact, that the more recent researches of organic chemistry bear upon and throw some light on the synthetical processes going on in plants; but, notwithstanding this, the efforts both of chemists and of phyto-physiologists have hitherto failed to state with certainty the progress and causes of the different reactions, decomposition, or formation going on in plants. The great difficulty and obstacle to this kind of research is that the chemical reactions of the plants are chiefly taking place in the plasma of the cells, which has to be considered as a mixture of many substances, most of them unknown, which are permanently subjected to changes by the influence of physical forces. We do not as yet possess the means of experimenting upon such a mixture, nor are we enabled to isolate therefrom single substances, nor is it at present possible to follow up all the phases of the various conversions of matter which take place, and hence we have been limited in our research to microscopical investigation of the processes going on in the protoplasma so far as these can be observed. Chemistry has taken another step in this field of research, and has tried to find out how far the growth of the plant depends on the presence of certain mineral matters, thus fixing the physiological value of the minerals to plants, as proved by Nobbe's researches. Although very valuable knowledge of the general requirements of plants in respect of mineral matters is thus obtained, we have not learnt the true chemical processes—the *modus quo*—how the various mineral matters act in the process of formation of the organic substances. In making experimental researches in this direction, it is necessary in the first place to discover proper methods, and I have adopted one which, so far as I know, is quite novel, and differs from other methods in that it tries to draw conclusions from facts already known, aided by experiments made beyond the interior of the plants, in order to ascertain what takes place in the interior. I considered that it might perhaps be possible to ascertain certain reactions beforehand, by relying upon certain initial facts of the agentia active in plants, and thus to learn deductively (*deductiv*) the further conversions or mutual reactions of matter that take place in them.

While engaged in extending the chemical facts required for my ultimate conclusions, I discovered and investigated some simple reactions, the results of which I am about to describe in the following part of my essay. In the first place, I considered the conversions which the mineral salts sucked up by the roots undergo in the interior of plants. That saline solution comes into contact with the acid juices produced by the plant, which juice always contains a certain proportion of free vegetable acids, viz., oxalic, tartaric, malic, &c. Considering these organic acids to be, at least in relation to the mineral salts, the main active principles of the juices contained in plants, I thought it best to investigate their action upon such of the mineral salts as are prominently active in the nutrition of plants.

Owing to the enormous extent of this field of research I had at the outset to limit my investigation to a few special points, and selected such reactions as appeared to me undoubtedly to take place within the interior of plants. It may be taken for granted that plants absorb nitrates from the soil, and also that oxalic acid is largely dispersed through them, and hence I investigated the action of oxalic acid upon the nitrates of lime, potassa, and soda. The experiments with lime salts are easily made. I used very dilute solutions, in order to imitate as much as possible what takes place in the plants themselves; I investigated the reactions between oxalic acid and nitrate of lime in all possible conditions; I determined the influence of time, of degree of concentration, of excess of either of the two salts, of the presence of foreign salts—in fact, I operated in all directions. I found that oxalic acid separates a portion of the lime in the shape of a crystalline oxalate, while nitric acid is set free. The quantity of lime thus precipitated depends entirely on the conditions under which the experiment is made; the greater the dilution of the fluids and the shorter the duration of the action, the smaller is the quantity separated; but even in very dilute solutions it is relatively very large, and when the duration of the experiment is sufficiently long, the precipitation is almost complete, viz., complete decomposition of the nitrate of lime with formation of oxalate. An instance of the progress of the reaction will prove this. With a degree of dilution corresponding to 1 equivalent = 28 of lime (in the shape of nitrate of lime) and 1 equivalent of oxalic acid in 200,000 c.c. of water, there was precipitated of the 28 of lime—

After 15	minutes time	13·2 or 47·1	per cent.
,, 18	hours ,,	20·8 ,, 74·2	,,
,, 70	,, ,,	22·4 ,, 80·0	,,
,, 168	,, ,,	22·8 ,, 81·4	,,

The formation of a precipitate only ceases when the liquid is highly diluted, because precipitation is then counteracted by the solubility of the oxalate of lime. I further found that the separation of oxalate of lime is increased as much by an excess of nitrate of lime as by an excess of oxalic acid, while the nitric acid acts as a solvent; I hence inferred—and found confirmed by experiment—that the solvent capability of the nitric acid is lessened by the addition of oxalic acid, so that, to a certain extent, the one acid counteracts the other.

As regards other and more exhaustive details, I shall have to refer my readers to my work on this subject, which is to be shortly published. The main result of my researches is therefore the following:—That, under all conditions, nitrate of lime and oxalic acid act upon each other in dilute solutions in such a manner that, while nitric acid is set free, oxalate of lime is precipitated; and since these substances occur also in the juices of plants it is clear that there the same reactions take place, and consequently the vegetable juices must of necessity contain free nitric acid. The oxalate of lime thus separated in the plants plays the part of a by-product, which is deposited in proper spaces, either cells or membranes; this fact I elucidated by microscopic research, because I found that the oxalate of lime precipitated from the dilute solutions I operated upon is, when viewed by the microscope, distinctly crystalline, while the size and mode of grouping together of the crystals seem to depend upon the dilution of the solution. The shape of the crystals just mentioned agrees exactly with that of the oxalate of lime most frequently in plants. They are monoklinoedrical prismas, belonging to the orthoclase shape, which have a great tendency to form twins, and are often united into crystalline agglomerations frequently met with in plants, and termed by botanists morning stars, on account of their peculiar shape.

I have not succeeded in producing raphides artificially, but I do not doubt that I may also obtain these by a proper arrangement of the conditions of the experiments. It is clear that the investigation of the decomposition of the potassic and sodic nitrates, supposing it to take place in an analogous manner, is far more difficult. Although it is a fact that, by the distillation of a mixture of nitrate of potassa and oxalic acid in the presence of a small quantity of water, fumes of nitric acid are given off, it would be quite erroneous to infer from this fact what might happen in very dilute solutions. I had therefore to devise a method which would not only admit of the detection of the reactions (double decomposition) in very dilute solutions, but this without the further addition of any chemical reagent, by which perhaps the conditions of the reaction might be altered. I found a method, although in a somewhat circuitous way, which answered my purpose, and has, moreover, the advantage of being applicable to the solution of the question of the mutual decomposition of salts—for instance, chloride of sodium and sulphate of magnesia, when in solution.

This method is based upon diffusion, and the principle may be elucidated in the following manner: Let us suppose that we have a solution of a salt, of which it is premised that it is not altered by the chemical action of the water, and that this solution (without the aid of an intermediate membrane) is allowed to diffuse in pure water, by pouring a layer of water very gently upon the saline solution, and leaving the vessel containing the liquid to stand quietly. After some time layers, varying in thickness, will be formed, each containing variable quantities of the salt; but the relation between the acid and basis will be everywhere the same, since the salt is not decomposed. Let us now suppose that, at the outset, a second substance has been added to the saline solution, which exerts a decomposing action upon the salt, then in that case the new compounds, one of which contains the base, the other the acid, of the salt, will have a different capability of diffusion, and consequently after some time the two constituents of the salt, while forming layers of different thickness, will not be present in the constant relation of the equivalents, but in a more variable proportion.

When the diffusion process is interrupted at the proper time, and the composition of the substances present in the different layers is determined by properly conducted chemical analysis, the results will prove whether a decomposition of the salt has taken place.

As regards the objections which might be raised against the applicability of this method, these I shall fully answer in my large work on the subject. By the use of this method, I have succeeded in giving a definite answer as regards the decomposition of the alkaline nitrates; but I will adduce here only one of the many experiments I have made:—1 litre of solution, which contained, upon 200,000 c.c., 1 equiv. of oxalic acid and 1 equiv. of nitrate of potassa, was placed in a tall cylindrical-shaped glass vessel, and upon that solution 1 litre of pure water was cautiously poured, and left to diffuse for a period of four weeks, after which I analysed two portions of the fluid, viz., an upper and lower layer. If no decomposition had taken place, I should have found in both layers the equivalent proportions of potassa and nitric acid; I, however, found in the upper layer an excess of nitric acid greater than that corresponding to the potassa equivalent, and in the lower a negative deviation; hence it might be inferred that decomposition had really taken place, and, as a control for the accuracy of the analysis, it was evident that the positive and negative difference of the upper and lower layers ought to possess equal value within the limits of faults of experiments. The difference amounted—

In the upper layer, to $+0{\cdot}20$
In the lower layer, to $-0{\cdot}32$

Taking into consideration the very small quantity of substance which, owing to the great degree of dilution of the liquid, could be operated upon, and also the difficulty of the estimation of nitric acid, and the constant influence of faults of experiments, by which the positive difference is lessened and the negative increased, I think a greater degree of agreement could hardly be expected than that just quoted; but, moreover, I made many similar experiments, and also corresponding ones with nitrate of soda. There can be, therefore, no doubt that the alkaline nitrates are in like manner decomposed, at least in part, by oxalic acid in very dilute solutions by the addition of oxalic acid.

It is true that I have not yet quantitatively estimated the relative quantity of nitric acid which is set free, but it must be observed that almost insuperable difficulties exist in such an estimation. It is probable that the alkaline nitrates are only partly decomposed, and by no means so completely as the nitrate of lime, because all the products of the reaction remain in solution, so that consequently, according to the well-known principles of the chemical influence of masses, the liquid comes to a state of equilibrium with which every reaction ceases.

By these researches we obtain some insight into a definite chemical process as it occurs in plants; we learn by what process the oxalate of lime so frequently met with in plants, and also the binoxalate of potassa, owe their origin, and we further find that the free nitric acid in the living plant is an active agent which plays a considerable part in the formation of the nitrogenous organic matters. Although it might be a pleasant field of further speculative discussion, I do not consider that we can enter more fully upon it so long as our knowledge of the first products of the reduction of carbonic acid are so scanty as at present. I think it very probable, however, that the nitric acid does not remain long unaltered, but is soon converted into either ammonia or hydroxylamine by the powerful reducing agency of the plants, while these last-named products in nascent state react upon the unequally nascent products of the reduction of carbonic acid, and thus together lead to the formation of organic nitrogenous compounds.—*Ber. d. Deutsch. Chem. Gesells.*

CORRESPONDENCE.

A GENERAL INDEX TO THE VOLUMES OF THE "CHEMICAL NEWS."

To the Editor of the Chemical News.

Sir,—I have just received the copious index to the last volume of the Chemical News, and am thereby reminded to ask whether you have any intention of giving your readers, sooner or later, a general index to the whole of the published volumes. I am sure that most, if not all, of your subscribers would, like myself, gladly pay any reasonable sum for so extremely useful a compilation.—I am, &c.,

John Attfield.

17, Bloomsbury Square, W.C.,
January 7, 1873.

[The twenty-six indices would make about 150 pages. The cost of printing would be very considerable, and we could not anticipate more than a limited number of purchasers. When the subject was mooted some time ago we only had a dozen or two replies. If, however, a sufficient number will guarantee the expense it shall be commenced at once.—*Ed. C. N.*]

THE ESTIMATION OF SULPHUR IN PYRITES.

To the Editor of the Chemical News.

Sir,—I cannot see that Mr. Holland's paper is a very valuable contribution to our knowledge on the estimation of sulphur in pyrites. He gives us a new method of fusion which I certainly think is not an improvement upon the fusion in porcelain crucibles in the absence of platinum. Again, anyone having had much experience with the estimation of sulphur in pyrites would never resort to the incorrect method of fusion. I have found, after many years' experience, that a sulphur estimated by the fusion process is always half per cent or rather more than by the acid way. I have assayed ores by fusion which have been done by some of our well-known analysts, and have always found that I have obtained a higher result; it surprises me how Mr. Holland has so cleverly overcome the difficulty, for I see that his fusion and acid processes agree. I know there is a troublesome way of purifying the barium sulphate, but from reading the paper I should not think Mr. Holland has employed it. I would prefer the fusion process in platinum crucibles to all others, if it gave correct results; and therefore Mr. Holland would be conferring a great boon upon chemists if he would describe the method by which he gets such good results.—I am, &c.,

Experience.

FLUORESENCE AND THE VIOLET END OF A PROJECTED SPECTRUM.

To the Editor of the Chemical News.

Sir,—In reading over my article in your journal of Dec. 6, which has just arrived, it strikes me that some may be puzzled by a statement on page 273 unless a further explanation is made.

It is well known that the bisulphide of carbon will only transmit rays of the spectrum as high as about 17° of the Bunsen scale, or a little above the line H′, and it might therefore be asked how invisible lines could be shown on a fluorescent screen with bisulphide of carbon prisms. The fact is that even with a powerful electric light, so feeble is the illuminating power of the violet rays that nothing is visible on an ordinary screen, when a spectrum some 10 feet long is thrown much above 10 of the scale; while thallene, being strongly excited by rays even as low as 9 or F, turns the *practically invisible* violet lines into *brilliant* green ones. It would have been more strict to have said "above the upper end of the spectrum visible on the screen, in place of "above the violet end of the spectrum;" for though this seems to be the violet end, and is usually so called by lecturers, it is not identical with what is strictly so named in other connections.

Thus the lines shown in the lecture referred to, were the lines in that part of the violet not visible otherwise under the other conditions of the experiment, and not the extra violet lines.

With glass prisms higher lines can be shown; and with two fine quartz prisms and a lens of the same substance, which we have in our collections, I have projected all the lines of the strictly actinic or invisible spectra of the metals used, but on account of the smaller dispersion of these substances, the experiment is much less effective than that made with bisulphide of carbon prisms as described.—I am, &c.,

Henry Morton.

Stevens Institute of Technology, Hoboken, New Jersey,
Dec. 30, 1872.

MISCELLANEOUS.

Metropolitan Gas Supply.—The reports of the chief gas examiner, just presented to the Corporation of London and Metropolitan Board of Works, show the average quality and purity of the gas supplied during the past quarter by the three companies under his supervision, as follows:—

	Illuminating power. Candles.	Sulphur. Grs. per 100 ft.	Ammonia. Grs. per 100 ft
Chartered Company:—			
Beckton	17·00	11·52	0·69
Bow	17·31	6·70	0·50
Blackfriars ..	17·31	16·10	0·12
Westminster ..	16·76	21·55	0·42
Pimlico (cannel)	24·25	10·38	0·42
Imperial Company:—			
Fulham	17·23	33·19	0·69
St. Pancras ..	15·85	32·04	0·05
Haggerstone ..	16·07	27·32	0·02
South Metropolitan	16·24	33·72	0·00

Short interruptions to the testings happened at some of the stations during the stokers' strike, and a deficiency of illuminating power was reported on a few occasions, but these have been certified as having occurred from "unavoidable cause." On all other occasions the quality of the gas has been above the statutory requirements.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 6, 1873.

This number contains the following original papers and memoirs relating to chemistry:—

Nitrification of Garden-Mould.—J. B. J. D. Boussingault.—This exhaustive monograph treats on the formation of nitre in the nitre-beds, and in arable and garden soils.

Some Combinations in which Phosphorus Appears to be Present in an Allotropic State, similar to that of the so-called Red Phosphorus.—A. Gautier.—After referring to a suboxide of

phosphorus, P_4O, discovered in 1837 by Le Verrier, the author points out that there are several compounds of phosphorus, the real composition of which is not at present well known some of them being amorphous. The main portion of the essay is devoted to the description of a compound formed by the action of protochloride of phosphorus upon phosphorous acid when these substances are heated in sealed tubes to a temperature of about 170°; the result in this instance is the formation of amorphous phosphorus according to the formula—$3PCl_3+7PH_3O_3=4P+3P_2H_4O_7+9HCl$. When these substances are only heated to 79° the reaction is different, and there is formed a compound P_4HO according to the following formula:—

$$11PCl_3+27PH_3O_3=4P_4HO+11P_2H_4O_7+33HCl.$$

The body alluded to is yellow-coloured, amorphous, unaltered by exposure to dry air, insoluble in water, alcohol, ether, benzin, chloroform, oil of turpentine, glycerine, acetic acid, protochloride of phosphorus, and protochloride of antimony. The substance is very stable, and bears heating in a current of dry carbonic acid to 250°. At 265° some phosphuretted hydrogen is given off, and at 350° to 360° phosphorus distils over. When heated in contact with air, this body (P_4HO) burns slowly; mixed with chlorate of potassa it detonates by the application of a smart blow. Dilute acids do not act upon it, but ordinary nitric acid gives rise to violent reaction. Water at 170° decomposes the compound with formation of pure phosphuretted hydrogen PH_3, and phosphorous as well as hypo-phosphorous acids. Alkalies decompose P_4HO, which unites with ammonia. The author concludes his paper with some observations on Le Verrier's suboxide of phosphorus, which he thinks may be identical with the compound obtained by him (see *Annales de Chimie et de Physique*, 2nd series, vol. lxv., p. 257).

Estimation of Ammonia in Illuminating Gas.—A. Houzeau.—The detailed description of a volumetric process, in which dilute sulphuric acid of known strength, and also an ammonia solution of definite strength, are applied; the gas is passed from the meter through the acid. According to the author the gas at Rouen was found to contain on an average 0·1042 grm. of ammonia in 100 litres of gas, while the gas in Paris only contains 0·009 grm. of ammonia in the same bulk.

There are also several original papers relating to mathematico-physical and natural history sciences.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No. 11, 1872.

Contains no papers relating to chemistry.

Journal für Gasbeleuchtung und Wasserversorgung, No. 23, 1872.

The contents of this number relate only to gas- and water-works engineering.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 12, 1872.

Bleaching Cotton, Flax, and Rags Intended for Paper-Making, &c., by Means of Ozone.—M. David.—The author ozonises air by passing it over a mixture of permanganate of potassa, peroxide of manganese, and sulphuric acid contained in large carboys. He then conveys the ozonised air into a brick tank, which contains the materials to be bleached. After some some hours' contact with the ozonised air they are all perfectly bleached and clean.

Although not belonging to chemistry, we call attention to the following memoir:—

Bascule Balances and Weighing Instruments.—L. Paupier.—Illustrated by several woodcuts. This essay describes weighing-machines largely used abroad but almost unknown in this country. These machines are in every respect superior to the ordinary balances in use, especially for heavy weights.

Steam-Boiler Anti-Crustation Composition.—Bonatte and Co.—The constituents of this material are not specified, but it is stated to be very effectual, safe, and anti-corrosive.

Iron Ore from Andorra.—H. Flobert.—It appears that the mineral resources of the country alluded to (the most ancient Republic of Europe) are beginning to attract attention. In addition to excellent qualities of fine marble, copper and lead ores, and useful mineral waters, there is abundance of excellent iron ore free from sulphur and phosphorus, and having, according to the author's analysis, the following percentical composition:—No. 1—Water, 7·24; peroxide of iron, 87·215; siliceous matter insoluble in acids, 3·103; manganese, 0·35; other matters (not specified) soluble in acids, 2·092; total, 100·00; percentage of metallic iron, 61·50. No. 2—Water, 8·60; peroxide of iron, 74·13; insoluble in acid, 10·60; soluble in acid (not specified further), 6·495; manganese, 0·165: total, 100·0; metallic iron, per cent, 51·9.

Trade in Esparto Grass (Lygæum Spartum) of Algeria.—Ch. Mène.—This paper contains statistical and other interesting information on this subject.

Bulletin de la Société Chimique de Paris, December 15, 1872.

From the *proces-verbaux* of the meetings of this Society, published in this number, we quote the following:—

Preparation of Di-Isopropyl.—R. D. Silva.—The author observes that Dr. Schorlemmer's statement concerning the inactivity of sodium upon the iodide of isopropyl is not quite correct, since the author found that decomposition ensues at from 120° to 130°. With the evolution of gas (C_3H_6 and C_3H_8) simultaneously there is obtained a hydrocarbon, C_9H_{20}, boiling at 130°; constitutional formula—

$$\begin{array}{l} CH_2-C_3H_7 \\ | \\ CH\ -C_3H_7 \\ | \\ CH_3 \end{array}$$

This investigation was instituted with the view of obtaining an alcohol, $C_6H_{13}OH$, from the chloride $C_6H_{13}Cl$ obtained by Dr. Schorlemmer by means of di-isopropyl, but this research is not yet finished.

Lactate of Lime.—A. Petit.—When a solution of this salt is treated with phosphoric acid so as to form a decimal solution (*solution audixieme*) of lacto-phosphate of lime, there is formed a liquid which, when cold, is quite clear and free from any precipitate; but when hot, a precipitate is formed, which almost re-dissolves on cooling.

This number further contains the following original essays and papers:—

Two Pentachlorides of Benzine.—E. Jungfleisch.—This lengthy essay is chiefly written to explain the objections made by Dr. Ladenburg, and published in a German scientific periodical, against the author's researches on this subject, which will be shortly published *in extenso*. It appears, however, that there is a difference of the action of pure dry chlorine upon benzine, and of that gas in wet state, which apparently has escaped Dr. Ladenburg's notice.

Chlorhydrate of Narceine.—A. Petit.—This paper treats chiefly on the solubility of narceine, its chlorhydrates and their mode of preparation. Narceine is very soluble in caustic potassa solution (0·15 thereof dissolves 1 grm. of the alkaloid), and in caustic ammonia, which leaves the narceine, after evaporation, in crystalline state. Narceine is soluble in 769 parts of water; narceine + HCl in 277 parts of water; narceine + 2HCl in 150 parts; narceine + 3HCl in 130; narceine +4HIC in 50.

On the Hydrates of the Monobasic Fatty Acids.—E. Grimaux.—This exhaustive monograph, elucidated by a large number of complex formulæ, is not well suited for abstraction.

Polytechnisches Journal von Dr. E. M. Dingler, first number for December, 1872.

New Method of Preparation of Caustic Soda.—W. Helbig.—The main gist of this paper relates to the oxidation of some sulphur compounds, present in the crude materials (the concentrated lye), by means of a forced current of air passed into the concentrated liquor instead of the use of saltpetre. From the account here given, it appears that while the last-named salt cannot be quite dispensed with the quantity has been greatly decreased.

Estimation of the Quantity of Juice Present in Beet-roots.—F. Jicinsky.—This essay, illustrated by woodcuts and elucidated by several tables, contains a detailed account of the best methods of estimating the quantity as well as the saccharine value of the juice of beet-roots.

Priew's Steam-Clearcing Method.—Dr. Dingler.—This paper, also illustrated by engravings, contains the account of a newly-devised method of clearcing sugar by means of low-pressure steam and air mixed, instead of the use of a pure concentrated sugar solution. The process is carried on in connection with centrifugal machines.

Application of Steam for the Purpose of Extinguishing Fires.—Dr. H. Weidenbusch.—This essay treats exhaustively on the application of steam for the purpose of extinguishing fires. The author quotes several well known instances in which steam, superior in every respect to water, has been successfully used to arrest the spread of, and rapidly extinguish fires.

Gas-Tight Impermeable and Indestructible Corks.—F. Ruschhaupt.—The process here described consists in soaking the corks in pure molten paraffin, whereby, according to the author, the corks are rendered perfectly impermeable to gases and a great many liquids (all those which do not act upon nor dissolve paraffin), while the corks are rendered to some extent indestructible.

The American Journal of Science and Arts, December, 1872.

In addition to a series of original papers relating to other physical sciences, this number contains the following original papers bearing upon chemistry:—

Note upon Aventurine Orthoclase Found at Ogden Mine, Sparta Township, Sussex Co., N.J.—Prof. Leeds.—After giving a geognostico-mineralogical description of this mineral, the author quotes the following chemical analysis per cent:—Silica, 64·81; alumina, 19·02; ferric oxide, 0·23; lime, 1·26; magnesia, 0·59; potassa, 14·30; loss by ignition, 0·26.

On Soil Analyses and their Utility.—E. W. Hilgard.—This paper has already appeared in full.

On a Crystal of Andalusite from Delaware Co., Pa.—E. S. Dana.—Illustrated with woodcuts.

Journal für Praktische Chemie, No. 16, 1872.

This number contains the following original papers:—

Contribution to Our Knowledge of Diabase.—R. Senfter.—This exhaustive monograph is an appendix to T. Petersen's researches on green stones (see Chemical News, vol. xxvi., p. 288), and is elucidated by a series of tables exhibiting the results of analyses of a large number of minerals. The main results of the author's investiga-

tion may be summarised as follows:—The diabases contain regularly a triklinic (*triklinen*) alkali felspar, which has to be considered as oligoclase; while in addition to that often a lime felspar is found, which is probably labradorite. The second main constituent of diabase is genuine augite, in which the quantity of lime is about equal to that of the magnesia and protoxide of iron. Diabase also contains protoxide of iron-magnesia-chlorite (*Eisenoxydul-magnesia-chlorite*), the composition of which agrees with the usual formula assigned to chlorite. Titanium-containing magnetic iron and apatite never fail to be present in diabase; while calcite also is a regular constituent of diabase, although it is only present in small quantity. To the genuine diabase, which frequently contains, or is mixed with other minerals, belongs many kinds of rocks usual designated hyperites.

Electrolysis of Itaconic Acid.—G. Aarland.—This essay is divided into the following sections:—Introduction, containing a review of electrolysis as applied to organic substances; preparation of itaconic and mesaconic acids; behaviour of citraconic, itaconic, and mesaconic acids with chloride of iron; detailed account of the electrolytic experiments, elucidated by a large number of complex formulæ.

Behaviour of Carbonate of Magnesia towards Gypsum in the Presence of a Solution of Common Salt.—Dr. E. Fleischer. —This paper contains an account of a series of researches made by the author with the view of ascertaining the mutual reactions which take place when the carbonates of lime, magnesia, baryta, and the sulphate of lime are boiled together in water, either pure, or containing common salt. Notwithstanding the comparatively great insolubility of some of these substances, double decompositions take place in some cases amounting to more than 30 per cent.

On Coal-Tar and Coal Tar-Pitch (Asphalte).—Dr. E. A. Behrens.—The first part of an exhaustive monograph; this portion is divided into the following sections:—Coal-tar in general; coal-tar pitch.

Pharmaceutische Zeitschrift für Russland, No. 19, 1872.

In addition to several papers relating to pharmaceutical science' this number contains an interesting memoir:—

On Fish Poison.—Dr. A. Casselmann.—It appears that in several parts of the Russian empire cases of poisoning caused by the eating of salt fish, chiefly *Accipenser Beluga*, a kind of sturgeon, are by no means rare. Chemically, the author cannot find the cause of the origin of this poison, which curiously fails to affect cats and dogs.

No. 20, 1872.

This number contains no original papers relating to chemistry.

No. 21, 1872.

This number contains, in addition to papers relating to pharmaceutical science, the following memoir:—

Alkaloids of the Papaveraceæ.—H. Ludwig.—The catalogically arranged enumeration of the alkaloids met with in opium (product of the *Papaver Somniferus*) and those met with in the *Papaver Rhœas*.

No. 22, 1872.

The papers published in this number only relate to pharmaceutical science.

Bulletin de la l'Academie Imperiale des Sciences de St. Petersbourg, vol. xviii., No. 1, September, 1872.

The original chemical memoirs in this number have been already noticed (see CHEMICAL NEWS, vol. xxvi., p. 265).

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2181. J. Robey, Manchester, "Improvements in the manufacture of a substitute for animal charcoal, to be used for purifying sewage and various other substances."—Petition recorded July 20, 1872.

2667. E. Ross, St. Mary Axe, London, "An improved method of utilising and giving additional value to the products of the coffee-bush."—Petition recorded September 9, 1872.

3270. C. Rave, Cureghem-lez-Bruxelles, Belgium, "The manufacture from mahogany and other woods of a colouring matter similar to cashoo."—Petition recorded October 18, 1872.

3306. H. Page, Market Buildings, Mincing Lane, London, "Improvements in the manufacture of paper-pulp, or half-stuff."—Petition recorded November 16, 1872.

3585. F. M. Lyte, Asnières, France, "Improved process of treating and purifying crude phosphoric acid, and in the production of soluble phosphates; also for the manufacture of phosphorus, and the treatment of certain residues resulting therefrom, and phosphate of alumina."—A communication from Henri Storck, Edouard Hentsch, Auguste Hentsch, Andre Lutscher, and Frederic Grininger, Asnières, France.—Petition recorded November 28, 1872.

3609. T. Richardson, J. W. Richardson, and A. Spencer, West Hartlepool, Durham, "Improvements in refining or puddling iron and steel."—Petition recorded November 30, 1872.

3741. W. A. Lyttle, Hammersmith, Middlesex, "Improvements in candles."—Petition recorded December 10, 1872.

3780. P. Love, Bedford, "Improvements in machinery for excavating and treating substances excavated, especially applicable for the conversion of bog-moss or fen into peat for fuel."—Petitions recorded December 13, 1872.

3799. S. Hickson, King's Road, Bedford Row, Middlesex, "Improvements in preserving meat."—Petition recorded December 14, 1872.

3813. A. M. Clarke, Chancery Lane, Middlesex, "An improvement in artificial fuel."—A communication from E. F. Loiseau, Pennsylvania, United States of America."—Petition recorded December 16, 1872.

3821. J. L. F. Target, Portsdow Road, Middlesex, "Improved means or apparatus for receiving human excreta, and for distributing, deodorising, or disinfecting powder over the same.

3829. J. F. Lackersteen, Lombard Court, City of London, "Improvements in the manufacture of hydrogen gas."

3830. H. Page, Mincing Lane, London, "Improvements in the manufacture of paper-pulp or half-stuff."—Petitions recorded December 17, 1872.

3851. S. Holker, Lumb, Lancaster, "Improvements applicable to the treatment of straw, esparto, wood, and similar substances used in the manufacture of paper."—Petition recorded December 18, 1872.

3853. F. B. Houghton, Southwark, Surrey, "Improved method of, or process for, treating spent hops for the manufacture of paper-pulp." —Petition recorded December 19, 1872.

3882. W. W. Fereday, Dover Road, Surrey, "Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly-concentrated manure."—Petition recorded December 21, 1872.

3889. J. Senior, New Ross, Wexford, Ireland, "An improvement in the process of unhairing and preparing skins or hides to be employed for making or dressing into leather of any kind."—Petition recorded December 23, 1872.

3913. L. A. Badin, New Ormond Street, Middlesex, "Improvements in closets and apparatus for collecting and disinfecting fœcal matters, and converting the same into manure or human guano."

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

3843. G. Haseltine, Southampton Buildings, London, "An improved method of, and apparatus for, rendering and drying animal matter, deodorising noxious gases, and treating blood to utilise it for agricultural and similar purposes."—Petition recorded December 18, 1872.

3968. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of steel, and in apparatus employed for this purpose."—A communication from T. R. Scowden, Cincinnati, U.S.A.—Petition recorded December 31, 1872.

NOTICES TO PROCEED.

2456. E. T. Hughes, Chancery Lane, London, "Improvements in the manufacture of loaf sugar, and in the machinery or apparatus employed therein."—Petition recorded August 17, 1872.

2491. C. F. Sebille, Paris, "Improvements in the composition known as 'schisto-asphaltic and bituminous beton,' and novel applications thereof, together with improved machinery or apparatus in connection therewith."—Petition recorded August 22, 1872.

2528. J. F. Parker and A. Wade, Birmingham, Improvements in the manufacture from coal and petroleum of hydrocarbon gas, or gas for illuminating and heating."—Petition recorded August 26, 1872.

2529. H. A. Dufrené, Paris, "An improved mode of preserving fruit."—A communication from F. Sacc, Neuchatel, Switzerland.

2538. H. Y. D. Scott, Major-General, C.B., Ealing, Middlesex, "Improvements in the treatment of sewage and in the preparation of manures therefrom."—Petitions recorded August 26, 1872.

2805. W. Rath, Plattenburg, Westphalia, "Improvements in annealing and removing of oxide or scale from iron and steel wire and other articles of iron and steel."—Petition recorded September 23, 1872.

3502. T. A. Howland and C. G. McKnight, both of Rhode Island, U.S.A., now of Southampton Buildings, London, "Improvements in the manufacture of gas and in apparatus therefor."—Petition recorded November 22, 1872.

3696. T. Green, Phœnix Chemical Works, Ouseburn, Newcastle-on-Tyne, "Improvements in the treatment of bones and other articles, and in apparatus for the same."—Petition recorded December 6, 1872.

3763. R. S. Casson, Brierley Hill, Staffordshire, "Improvements in puddling furnaces, heating furnaces, and other reverberatory furnaces used in the manufacture of iron and steel."—A communication from P. A. Dormoy, Troyes, France.—Petition recorded December 11, 1872.

3799. S. Hickson, King's Road, Bedford Row, Middlesex, "Improvements in preserving meat."—Petition recorded December 14, 1872.

PATENTS SEALED.

1984. W. E. Gedge, Strand, Middlesex, "A new or improved process of preparing phosphorus.—A communication from A. Peluche, Paris, France.—Dated July 1, 1872.

2004. W. Thwaites, Brixton, Surrey, and E. Fondeville and G. Bertin, Kentish Town, Middlesex, "Improved composition or admixture for preserving walls from dampness, and for other purposes."—Dated July 2, 1872.

2036. E. J. L. Caillot, Barcelona, Spain, "Improvements in the manufacture of lighting and heating gas, and in apparatus and burners connected therewith."—Dated July 5, 1872.

2044. W. Weldon, Putney, Surrey, "Improvements relating to the utilisation of dilute chlorine."—Dated July 6, 1872.

2093. J. R. Casbay, Newman Street, Oxford Street, Middlesex, "An improved compound to be applied to the surfaces of wood or metal to preserve the same from corrosion or decay."—Dated July 11, 1872.

2262. T. R. Crampton, Westminster, "Improvements in the manufacture of gas and fuel, and in apparatus to be used for this purpose."—Dated July 29, 1872.

2576. G. Spencer, Cannon Street, London, "Improvements in the purification of coal-gas used for illuminating purposes and for mechanical purposes, and in apparatus therefor."—A communication from E. White, New York, U.S.A.—Dated August 30, 1872.

2614. B. W. Gerland, Macclesfield, Cheshire, "Improvements in the manufacture of phosphoric acid, phosphatic manures, alkaline and other phosphates."—A communication from H. and E. Albert, Biebrich, Germany."—Dated September 3, 1872.

2766. W. E. Newton, Chancery Lane, Middlesex, "Improvements in the preparation of explosive compounds."—A communication from J. H. Norrbin and J. Ohlsson, Stockholm, Sweden.—Dated September 18, 1872.

3309. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of bleaching-liquor."—Dated November 7, 1872.

NOTES AND QUERIES.

Analysis of Sugars.—(Reply to "Subscriber.")—Consult Dr. Stammer's work, the title of which we have lately given in full.

Acid in Crude Sugar.—(Reply to J. M. Merrick.)—There may be some lactic and formic acids, but the acetic acid is the principal one, and is due to the previous formation of alcohol. Consult the work mentioned above.

MEETINGS FOR THE WEEK.

Monday, Jan. 20th.—Medical, 8.
Tuesday, 21st.—Civil Engineers, 8.
— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
— Anthropological, 8
— Zoological, 8½.
Wednesday, 22nd.—Society of Arts, 8.
— Geological, 8.
Thursday, 23rd.—Royal, 8½
— Royal Institution, 3. Dr. Debus, F.R.S., "On Oxidation."
— Royal Society Club, 6.
Friday, 24th.—Royal Institution, 9. Prof. Birks, "Analogies of Physical and Moral Science.
Saturday, 25th.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

THE CHEMICAL NEWS.

VOL. XXVII. No. 687.

ON THE UNION OF AMMONIA NITRATE WITH AMMONIA.*

By EDWARD DIVERS, M.D.

AMMONIA nitrate deliquesces in ammonia gas at ordinary temperatures and pressures, forming a solution of the salt in liquefied ammonia. To prepare the product it is only requisite to pass dry ammonia gas into a flask containing the dry nitrate, but the condensation proceeds more rapidly if the flask is surrounded with ice.

The liquid obtained varies in composition according to the temperature and pressure. At a temperature of 23°, and the pressure of the atmosphere, it consists of about 4 parts of nitrate to 1 of ammonia by weight; but under greater pressure, or at lower temperatures, much more ammonia can be condensed by the nitrate. At 0° and the pressure of the atmosphere, two parts of nitrate can condense one part of ammonia. The liquid boils when heated, and, when nearly saturated with nitrate, deposits crystals of it when cooled—just like an aqueous solution. It can also, like an aqueous solution, be heated above its boiling-point without boiling, and become supersaturated with the salt without crystallising. When poured out into an open vessel, it becomes almost instantly gelatinous in appearance—may, indeed, become so as it falls in a stream from the flask containing it. This effect is due to evaporation of ammonia and solidification of nitrate at the surface of the liquid; on breaking the crust of nitrate, the compound flows out as liquid as ever. It is not caustic to the dry skin. During its decomposition cold is manifested, and during its formation heat is evolved, but not to a great extent, because the heat given out by the liquefaction of the ammonia is nearly all used up in the liquefaction of the nitrate.

The specific gravity of the liquid varies, of course, with its composition. When it consists of two of nitrate to one of ammonia, it has a specific gravity of 1072·5, while it has a specific gravity of nearly 1200 when it consists of four of nitrate to one of ammonia. Its specific gravity can be calculated from its composition, by taking for the purpose 1524·5 as the specific gravity of the nitrate, and 671 as that of the ammonia. The number 1524·5 is much less than that expressing the actual density of the nitrate in the solid state, but does not differ very much from its apparent specific gravity in aqueous solution.

In its rate of expansion by heat, the liquid resembles others that exist as such at ordinary temperatures, rather than those that, like ammonia itself, are only retained as such by great pressure. Its expansivity increases with the quantity of ammonia present.

The volume of a mixture of the liquid with water is much less than the sum of the volumes of the liquid and the water, and yet a marked absorption of heat occurs during the admixture. The same thing happens when a concentrated aqueous solution of the nitrate is poured into water, as was first pointed out by Gay-Lussac. Other examples of this remarkable phenomenon have been observed by different chemists, and it has received various explanations. F. Mohr considers that heat is used up in the depression of the freezing-point of the water caused by the salt. As this depression of the freezing-point is probably attended by an increase in the latent heat of the water, his explanation appears to be the correct one. Thomsen finds the specific heat of the mixture to be less than the mean of the specific heats of its components.

Its action upon a great nnmber of substances, principally inorganic, has been tried, and found to be for the most part like that of ammonia (in the absence of water) and ammonia nitrate conjoined. The nitrate appears to undergo double decomposition with most salts, and the ammonia to unite with nearly all of them, including those of magnesium, aluminium, iron, and manganese. The ammoniated chromium salts possess considerable stability. The ammoniated mercuric iodide is resolved by washing into ammonia and mercuric iodide again. The ammoniated compounds which do not dissolve in the liquid are very bulky, as observed by Gore in his experiments upon ammonia liquefied by pressure. Nitrates, chlorides, iodides, bromides are either soluble as Gore has found them to be in ammonia alone, or else are decomposed into soluble chlorides, &c., of ammonium, and insoluble ammoniated compounds of the metals. Sulphates, oxalates, chromates, and arsenites are insoluble, and phosphates are nearly so. Phosphoric and chromic anhydrides do not act upon the liquid with the energy that might be expected, but combine with the ammonia. Iodine dissolves freely, as it does in ammonia alone (Gore). Bromine generates nitrogen. Lead salts, including sulphate, chloride, iodide. and oxide, are freely soluble as ammoniated compounds. Platinous chloride dissolves freely as tetra-ammonio-platinous chloride. Potassium salts are very sparingly soluble. Alkalies and their carbonates decompose the nitrate; so do litharge, lime, and baryta. Calomel is converted into metallic mercury, and a soluble ammoniated mercuric compound. Potassium, sodium, zinc, and cadmium dissolve without liberating gas, by reducing the nitrate to nitrite; potassium inflaming, magnesium slowly dissolves, liberating a little hydrogen, reducing the nitrate and becoming partly converted into Beetz's black suboxide of magnesium. Methyl iodide is decomposed; butyric ether and chloroform are sparingly soluble without decomposition. Ether is insoluble, but by its contact causes the liquid to break up into its two constituents.

It is a good electrolyte, ammonia and hydrogen appearing at the negative electrode, and nitrogen and ammonia nitrate at the positive electrode. Its decomposition may be thus represented:—

$$\overbrace{H_3 \text{ and } 3NH_3}^{-} \;\Big|\; \overbrace{N \text{ and } 3NO_3HNH_3}^{+}(=3NO_3+4NH_3).$$

Positive electrodes of silver, lead, copper, zinc, and magnesium are dissolved by the liquid as (ammoniated) nitrates. A positive electrode of mercury is converted into a compound almost insoluble in the liquid. When the electrode is acted upon, the generation of nitrogen does not take place.

* Abstract of a Paper read before the Royal Society.

ON CŒRULIGNON, A BY-PRODUCT OF THE INDUSTRIAL MANUFACTURE OF WOOD-VINEGAR.

By C. LIEBERMANN.

CŒRULIGNON is the name given to a new substance, of a blue colour, first observed during the industrial purification of crude pyroligneous acid in the works of Herr Th. Lettenmayer, at Königsbronn. I obtained a small sample of cœrulignon through the kindness of Privy Councillor Dr. V. Fehling and Professor V. Meyer, who had observed that it dissolved in strong sulphuric acid, and was of a beautiful blue colour similar to that of the flowers of *Carduus Benedictus*. A larger sample having been forwarded to me by Herr Lettenmayer, I have been able to make an investigation of this substance, and to communicate the following details concerning its discovery and preparation:—

The crude acetate of lime, obtained by the saturation of the raw pyroligneous acid, is dried, in order to prepare wood-spirit (crude methyl-alcohol), and then, having been mixed with a sufficient quantity of hydrochloric acid, it is placed in stills, in order to separate the acetic acid. When this is mixed with a small quantity of a solution of bichromate of potassa, and left quietly standing for a while at the ordinary temperature, a blue-coloured film is gradually formed on the surface of the liquid, which, becoming more dense, forms gradually a violet-coloured sediment; this is the raw cœrulignon, which may be further purified by lixiviation with water. Viewed by the microscope, this substance is found to consist of small needle-shaped crystals, soluble in concentrated sulphuric acid, exhibiting a blue-coloured solution, from which, however, the substance cannot again be separated unaltered.

On being heated with caustic potassa solution, cœrulignon shows the following reactions:—At first the liquid assumes a green colour, which rapidly turns yellow; when it is evaporated and concentrated to the fusion-point of the potassa, the brown-coloured mass, when treated with water, yields a very deep violet-coloured solution, which, however, is not permanent, but akin to the alkaline solutions of logwood. The cœrulignon has hereby become converted into other compounds, which are with great difficulty isolated. The fact that cœrulignon is quite insoluble in all other solvents, and is, besides, neither sublimable nor distillable without decomposition by the aid of heat, made the purification of this substance rather difficult; it had been found still to contain a good deal of ash after the lixiviation process. I discovered, however, that phenol dissolves cœrulignon at the ordinary temperature, and produces a red-coloured solution, which, on being filtered, yields, by the addition of either alcohol or ether, a deep steel-blue coloured precipitate, consisting of very small needle-shaped crystals; and these crystals, after having been washed with either alcohol or ether, constitute pure cœrulignon, the chemical composition of which may be expressed by either of the two following formulæ:—$C_{15}H_{14}O_6$ or $C_{30}H_{30}O_{12}$.

Cœrulignon is a very stable compound, and nearly insoluble in all menstrua; it is not a dye, nor a pigment, and does not impart colour to fabrics either by itself or by the aid of mordants. It combines with glacial acetic acid (the anhydride), forming a colourless crystalline product; strong nitric acid converts it into oxalic acid. When cœrulignon is heated with hydriodic acid and amorphous phosphorus to 160°, the result is the formation of the pigment referred to when the potassa reaction was spoken of. This pigment dissolves in ether, producing a colourless solution, which, on being evaporated *in vacuo*, yields an amorphous mass. When this is treated with alkaline solutions, it exhibits a beautiful colouration, but one which rapidly fades.

As cœrulignon is insoluble in wood-vinegar, and not volatile, it cannot be contained as such in the distilled wood-vinegar, but must be formed after the distillation from some other substance whereon the addition of bichromate of potassa has some influence. The application of that substance to the crude vinegar is for the purpose of purifying the crude liquid, the result being the formation of a copious and brown-coloured precipitate. I have found that, in several different instances, this precipitate always contains cœrulignon, which may be detected by the following process:—From 30 to 40 c.c. of the crude wood-vinegar is mixed with one-fourth of its bulk of a cold saturated solution of bichromate of potassa. The ensuing precipitate is first washed with water, next boiled with alcohol, and then with glacial acetic acid, then dried, and lastly treated with phenol; thus a red-coloured solution is produced, which, having been filtered, yields, by the addition of alcohol, a deep steel-blue precipitate—and this is cœrulignon.

This experiment proves that the reason why the body just named has hitherto been entirely overlooked by wood-vinegar makers is, that the cœrulignon is separated with several other substances, while the quantity of the material from which it is generated in the crude wood-vinegar is not small. It has not yet been ascertained whether all kinds of wood yield this compound. The wood used at Königsbronn is beech and birch, and by the dry distillation these both yield cœrulignon; but I have also found this body in crude wood-vinegars, the origin of which, as regards the wood employed, is unknown to me.

Since I obtained the cœrulignon quite free from ash, thus proving that it is not a coloured lake, the idea has struck me that it is perhaps formed by the oxidising action of the bichromate of potassa upon some substance present in the crude wood-vinegar, and I therefore tried to recover that body by the reduction of the cœrulignon. This I effected by the aid of tin and hydrochloric acid, which, on being boiled with cœrulignon, yield a colourless solution. On the addition of chloride of iron, this solution becomes for a moment of a deep red colour, similar to that produced in the chloride by sulphocyanide of potassium, and next a beautiful violet-coloured crystalline precipitate of cœrulignon. The compound thus formed, which I term hydrocœrulignon, when prepared in the manner just described, is with difficulty obtained in a pure state, but is also formed in a somewhat complex reaction when potassa is made to act upon cœrulignon. When that body and caustic potassa are heated with some water, a yellow-coloured pasty mass is first formed, which is next treated with hydrochloric acid and washed with water; this resinous mass, when treated with boiling alcohol, yields a crystalline colourless compound.

The reduction of cœrulignon is rapidly effected by means of yellow-coloured sulphuret of ammonium, whereby heat is developed; and, after the addition of hydrochloric acid and washing, a compound soluble in alcohol is obtained, which, on evaporation of that liquid, again yields the colourless crystalline body.

An aqueous solution of sulphurous acid also reduces cœrulignon, at 170°, to beautifully crystallised hydrocœrulignon; sodium amalgam is not as good a reducing agent. Hydrocœrulignon is hardly soluble in water, but is soluble in alcohol and acetic acid; it fuses at 190°, and distils over undecomposed when cautiously heated, the distillate yielding large-sized colourless crystals. With the vapours of acetic acid, hydrocœrulignon is somewhat volatile. When treated with oxidising agents, viz., bichromate of potassa, chloride of iron, chlorine and bromine water, nitric acid, copper and silver salts, cœrulignon is again obtained, and with chloride of iron it may be titrated; for, as long as any cœrulignon remains, ferrocyanide of potassium does not yield prussian-blue. The formula of hydrocœrulignon is $C_{15}H_{16}O_6$; it combines with acetic anhydride and chloride of benzoyl, yielding compounds corresponding to those formed under the same conditions with cœrulignon. When ignited with zinc-dust, hydrocœrulignon yields a hydrocarbon in large quantities. Concentrated sulphuric acid dissolves hydrocœrulignon, exhibiting an orange-coloured solution, which, on being heated, becomes magenta-red. Hydrocœrulignon failed to act as white indigo does in the vat for dyeing. There can be no doubt that hydrocœrulignon is the substance present in crude wood-vinegar, which yields the cœrulignon; but in the industrial preparation of wood-vinegar by the decomposition of the acetate of lime with hydrochloric acid, only a small quantity of cœrulignon comes over with the distillate, since the larger part remains in the still. I found, from an experiment made, that, from a solution of hydrocœrulignon in acetic acid, the former is only distilled over in a somewhat larger quantity when a portion of the retort is overheated; but, since the product of the oxidation of hydrocœrulignon (viz., cœrulignon) is then largely formed, that substance may even be obtained on a large scale by the hundredweight.

The analysis and behaviour (with reagents) of the two above-mentioned bodies indicate that hydrocœrulignon,

$C_{15}H_{16}O_6$, is a compound belonging to the higher phenols. The green hydrochinon, $C_{30}H_{30}O_{12}$, or chinon, $C_{15}H_{14}O_6$, is the cœrulignon; but these formulæ are as yet only empirical, and derived from the percentically-obtained figures by analysis. When cœrulignon is left standing with concentrated sulphuric acid, heat is set free, and it yields a compound which, when treated with alcohol, is a brownish red crystalline isatine, a body which has the same composition as cœrulignon, but is not readily converted into hydrocœrulignon. I have every reason to believe that the precise formulæ of these interesting compounds will soon be found; and I also think there can be no doubt that, in the bodies under consideration, we have to do with a less far-fetched product of decomposition of woody fibre, or of the incrustrating matter of wood, than in the products of dry distillation of wood now known. —*Ber. d. Deutsch. Chem. Gesells.*

REMARKS UPON C. UNGER'S TREATISE ON THE CONSTITUTION OF ULTRAMARINE.

By W. MORGAN.

In *Berichte der Deutschen Chemischen Gesellschaft*, vol. v., p. 893, C. Unger has communicated his views respecting the constitution of ultramarine, and states as follows:—

"The chemical nature of ultramarine, notwithstanding the numerous investigations which have been made thereon, is by no means enlightened, and the general acceptation that it contains aluminium sulphide, or sodium sulphide, or sodium polythionate, is still very doubtful when one sees that ultramarine is not decomposed by fused potassium chlorate, and that it withstands decompositlon for some time when heated with alkalies and nitrates. It is true that ultramarine, when heated with soda-lime, yields at most but a trace of ammonia; *but if one heats it with fused microcosmic salt, or with an alkali acid sulphate, a considerable quantity of nitrogen will be liberated.*"

He then proceeds further, and concludes his treatise with a series of formulæ which would explain the whole series of reactions which take place in the manufacture of ultramarine:—

$$\underbrace{AlO_3+SiO_2+4Na_2S_2O_3+2Na_2CO_3}_{\text{Contents of mixture in furnace.}}=$$

$$\underbrace{AlSO_2+SiSO+2Na_2S}_{\text{Sulphobasic oxysulphuret.}}+\underbrace{4Na_2SO_4+2CO_2}_{\text{Which are removed.}}.$$

Thereto 2O from the air =

$$\underbrace{AlSiS_2O_5}_{\text{Ultramarinogen.}} + \underbrace{2Na_2S}_{\text{Which are removed.}}.$$

Thereto S in form of vapour =

$$\underbrace{AlSiS_2O_3}_{\text{Oxysulphuret.}} + \underbrace{SO_2}_{\text{Which is removed.}}.$$

Thereto 2N from the air =

$$\underbrace{AlSiS_2O_3N_2}_{\text{Ultramarine.}}.$$

In blue ultramarine Unger found 5·5 per cent of nitrogen. Although ultramarine has been the subject of numerous investigations and analyses during the last forty years, I have not been able to find any mention made as to the presence of nitrogen therein, and none of the analyses show a deficit of 5·5 per cent, which should be the case according to the quantity of nitrogen found by C. Unger. I became induced, under the guidance of Professor Will, to test the truth of his statements by the following experiments, the blue ultramarine used being previously washed out thoroughly and dried at 100° C.:—

(1). 3 to 4 grms. thereof were mixed with 12 grms. of *pure* acid sulphate of potassium, and the mixture brought into a combustion-tube, the ends of which were bent upwards—the one end being connected with a carbonic acid apparatus, the other end attached to a tube passing into a mercurial trough. After expelling the air as completely as possible by dry carbonic acid gas, the connection therewith was cut off, the tube gently heated, and finally raised to redness, the evolved gases were passed into a cylinder filled partly with mercury, partly with caustic potash, after the manner of nitrogen determinations; the total quantity of unabsorbable gas being 2 to 3 c.c., the which re-ignited a glowing chip when plunged into it, and showed the presence of oxygen mixed with air.

(2). In precisely the same manner the experiments were conducted with *pure* fused microcosmic salt, and again about 2 to 3 c.c. of unabsorbable gas were received, which proved to be air.

(3). 2 to 3 grms. of ultramarine, mixed with soda-lime, and heated in a combustion-tube connected with a Will and Varrentrapp's apparatus containing hydrochloric acid, into which the evolved gases were passed. At the close of the experiment the contents of the bulbs were tested for ammonia by adding chloride of platinum and alcohol, and not the least trace of a precipitate produced; and by Nessler's test but a trace of precipitate was yielded.

This last experiment was repeated with soda-lime alone, and the results showed that it evolved a trace of ammonia when heated.

These results speak for themselves, and conclusively prove that nitrogen is not a constituent of ultramarine, and that the formula $AlSiS_2O_3N_2$, put forward by C. Unger, is a false one.

Giessen, January, 1873.

ADULTERATION ACT, 1872.

The following suggestions on the Adulteration Act, 1872, have been circulated by the Vestry of St. Pancras:—

So soon as the necessary officers have been appointed by the vestry to execute the provisions of the Act, it will be necessary that the action of such officers be governed by regulations to be fixed by the vestry.

These regulations should be divided into two parts:—

1.—Those relating to private purchasers who may wish articles analysed.
2.—Those for the inspector under the Act, who should submit articles for analysis in his capacity as a public officer only.

Regulations for Purchasers Generally.

The Act of 1872, clause 9, provides for the payment of a fee for analysis of not less than 2s. 6d., nor more than 10s. 6d. As the object of the vestry should be to have the Act carried out efficiently, rather than to receive large fees; and as it would be difficult for the ratepayers generally to understand a scale of fees, whether governed by the value of the analysis or otherwise, there should be an uniform fee of 2s. 6d. charged to all purchasers of articles not intended for re-sale, and a fee of 10s. 6d. to all purchasers of articles intended to be re-sold.

The fee should be paid to the inspector, who should give a printed receipt for the amount, and all fees should be accounted for by him to the vestry clerk; and the inspector should not, under penalty of dismissal, be allowed to receive any fee or reward other than that fixed by the vestry.

When a sample is brought to the inspector by a private purchaser, such purchaser should make a declaration before the inspector, that the article brought for analysis has been purchased at a place within the parish; and the name of the vendor and place of purchase should be stated in the declaration. The sample should be divided into

three, and each portion enclosed and sealed by the inspector, in the presence of the purchaser; and the purchaser should also be allowed to affix his seal or other mark to each packet; but no name or other distinguishing mark should be placed on the sample, except the name of the article, and labels descriptive of any admixture. The inspector should at the time he receives the samples, enter in a form, provided for the purpose, the date, the name, and address of the person bringing the sample, the name and address of the vendor, a distinguishing number of the sample, and other particulars. One portion sealed, but *not* bearing the distinguishing number, should be returned to the purchaser, the second sealed and numbered should be retained by the inspector, and the third should be divided into two, each portion sealed, marked, and numbered (with a number corresponding to that on the second sample), in the presence of the analyst—one portion left with the analyst, and the other retained by the inspector, in order to prove the identity of the article.

The inspector should not, except as provided for in section 3 of the Act of 1860, give to the analyst the name of the person bringing an article for analysis, or the name of the vendor of such article.

The analyst should, in his certificate of the result of his analysis, refer to the particular sample analysed by number and description only, and the certificate should be so worded as that it cannot be applied to any other sample, or used in any other way for the purposes of advertisement.

The inspector should not be allowed to alter or interfere in any way with the certificate, so as to identify such certificate with the vendor of the article, or with any other person, and should not be allowed to give any form of certificate himself.

As to Articles Purchased by the Inspector.

There should be a systematic scheme of sampling.

The inspector should be only partially under the control of the analyst, *i.e.*, he should at the request of the analyst obtain samples of any given article from the dealers in such article, in any one ward or district of the parish; but in every other respect he should act only under the regulations of the vestry.

When required by the analyst to obtain samples of any article, he must obtain such samples, as far as possible, from all vendors of the article in the ward or district. He must, in the presence of the vendor, divide his purchase into three, and enclose each sample, and the inspector and the vendor should seal the same; but no name or other distinguishing mark should, *in the presence of the vendor*, be placed upon a sample, except the name of the article, and labels descriptive of any admixture. The inspector should leave one portion with the vendor, and should, immediately after leaving the vendor, attach a distinguishing number to the two samples in his possession, retain one himself, under seal, and sub-divide the other into two, in the presence of the analyst, retaining one sub-divided portion, and leaving the other with the analyst, and upon such portion the certificate of the analyst should be given.

The certificate to be given under the same conditions as above-mentioned in regard to a private purchaser.

When the analyst shall be of opinion that the result of an analysis of any article is such as to warrant the vestry instituting proceedings against the vendor, he should make a special report at once to that effect to the vestry, using only the number of the sample; and the vestry should thereupon, and without the name of the vendor being made known, resolve whether proceedings should be taken against such vendor.

The analyst should be required to provide a laboratory at his own expense, and all assistance and things necessary for the purposes of analysis. He should be paid by fixed salary, and not be allowed to receive any fees whatever, except fees for attendance in a court of justice on proceedings being taken by the vestry.

The forms, containing the names and other particulars with reference to the numbered samples, and such numbered samples should be kept in the custody of the inspector until the analysis is complete, and the certificate of the analyst given; and they should be then handed over to the custody of the vestry clerk, to be kept by him in the vestry's strong room; and no other officer or other person should have access to such forms, or to the sealed samples, except as ordered by a Court of Law upon any proceedings against the vendor of adulterated articles, or by the vestry.

Printed by order of the General Purposes Committee.

Thos. Eccleston Gibb,
Vestry Clerk.

UTILISATION OF COAL WASTE.

By E. F. LOISEAU.

An article on the "Utilisation of Waste Coal," very ably written, appeared in the October number of the *American Exchange and Review*, and was reproduced by almost all the American scientific papers. The anonymous author of this article has evidently studied the subject carefully, and his objections to the different processes which have been tried to solidify coal dust are serious ones; but his knowledge of the facts seems to be limited entirely to what has been tried in America, and he seems to possess only some general information about what has been done abroad.

Alluding to the manufacture of artificial fuel in Europe, the author of the article referred to says that, "for a number of years, the bituminous or semi-bituminous waste from the mines of Germany, France, and Belgium has been to a considerable extent successfully utilised, by mixing with it from 15 to 30 per cent of ordinary moist clay, and pressing this plastic mass into forms of any desired shape and size. The product, thus obtained, though of inferior heating quality, still secures a ready market, owing to the high price of the coal in the countries named, where it finds employment, not only for household purposes, but also for steam generation."

Not only is the dust of bituminous and semi-bituminous coal consolidated with clay in Europe; but in Belgium, at the mines of Baulet, Auvelais, Ham-sur-Sambre and Tamines-sur-Sambre, the dust of a very dry coal, called stone coal, similar to anthracite, is also manufactured into solid lumps by a clay mixture. In France, in the department of Izère, at La Sable, Vizille, Arroux, where pure vitreous and specular anthracites, resembling those of Pennsylvania, are mined, the same process is applied. It is also applied in South Wales. It is not the high price of the coal, which secures to the artificial fuel, thus made, a ready market—it is its lasting qualities, its regular size, its being free from slate, sulphur, and other impurities, and giving no smoke. The slack coal in Belgium is not worthless as it is here; it is used for baking bricks, tiles, &c., and its price is only 30 per cent below that of coal. The artificial fuel costs as much as the ordinary coal and sometimes more; still it is preferred to the ordinary coal.

The manufacture of bituminous and semi-bituminous waste into solid lumps by the use of coal-tar as a cement, has long ago been abandoned in Europe. Fluid pitch is still used at La Charotte, France, but all the other factories of France, England, Germany, and Belgium are using either clay or the residuum of coal-tar, submitted to boiling until it is freed of from 50 to 60 per cent of its volatile matters; it then constitutes dry pitch. This pitch is ground, mixed with the coal dust, in the proportion of about 8 per cent, conveyed by a propeller screw through a heated cylinder which softens the pitch, into a mixer, and from this mixer to a press, to be moulded into lumps of suitable sizes.

Although the lumps are submitted to almost complete

carbonisation, this coal is unfit for domestic purposes. It answers well for steamers, locomotives, &c., and it does not disintegrate, while burning, as the coal cokes before the pitch is consumed; but when pitch is mixed with anthracite coal dust, and pressed into lumps, these lumps disintegrate in the fire and the particles of coal fall through the grate without being consumed.

Some manufacturers, and among them, John Christie and Thomas Harper, in England, and Euryale Dehaynin, in France, thought that by more mechanical combination of materials, they could obtain results equivalent to a chemical change in the ingredients themselves; thus, that by the mixtures of anthracite and bituminous slack, a fuel could be obtained corresponding in its properties to steam, or semi-bituminous, coal; or that by mixing a good with a very poor coal, a fuel of a fair average quality could be obtained. Nothing could be further from the truth, for mere mechanical combination can in no way alter the nature of the several ingredients used. In the fuel thus made with a mixture of coals, each particle burned in the precise manner, and gave the results due to peculiar seam from which it was taken, whilst the pitch used for combining the small particles of coal gave out, in like manner, the flame, heat, or smoke due to its combustion under similar circumstances when not forming part of a block of artificial fuel.

The process of manufacturing artificial fuel from bituminous or semi-bituminous coal dust, by cementing the particles with pitch, would be as successful in this country as it is in Europe, if the price of the coal were higher than it is to-day; at the actual low price, it would not be a remunerative business. The same difficulty would exist in the application of the process to anthracite waste, even if a perfect product could be made.

Having described the process of Bessemer, in England, for consolidating bituminous coal dust without any cement, by heating the dust to a semi-caked plastic condition and pressing it afterwards in suitable moulds, the author of the article says that "this plan has received considerable praise from scientific critics, of which it is indeed well worthy. It is now stated to be in successful operation in several large manufactories in England."

Scientific critics have praised the process, it is true, but the practical application of it has been a failure. Although Bessemer's process has been considerably improved by Evrard and Baroulier in France, the expensive machinery required for its application and the defects of the fuel produced, which had a great heating power, but could not bear transportation, were sufficient causes for the abandonment of the enterprise. There does not exist, to-day, on the Continent, a single establishment where the manufacture of artificial fuel from coal waste, without cement, is carried on.

Although the writer of the article objects strongly to the use of mineral cements, he seems to think that several American processes for utilising coal waste by the use of grahamite as a cement, may ultimately prove successful.

Grahamite is an asphaltic mineral found in West Virginia; it may be classed with the albertite of New Brunswick and the bitumen of Trinidad. Like these, it expands when submitted to elevated temperatures, and it emits while burning the same unpleasant odour and smoke which made the use of coal-tar pitch as a cement so objectionable in a fuel prepared for domestic use. Any kind of asphalt would answer as well as pitch to manufacture from bituminous coal dust an artificial fuel for manufacturing purposes, if the low price of the coal were not, as it is now, an insuperable difficulty. Applied to anthracite slack, to manufacture an artificial fuel for the same purpose, asphalt will not answer, on account of its tendency to expansion, and for household purposes it will not answer better than the pitch, on account of the smell and smoke. There remains the long-tested and cheaper process of cementing the coal dust with clay.

The first experiment in the manufacture of what is termed "artificial fuel" appears to have been made about the year 1594, when Sir Hugh Platt attempted to intoduce into England, for use in common fire-places, a mixture of coal and clay, which he states to have been according to the manner of "Lukeland in Germany." He also used other mixtures, such as small coal with sawdust, tanner's bark, held together with loam or with cow-dung. These are set forth in a work published in 1603, and entitled "A New, Cheap, and Delicate Fire of Coal-Balls," by H. Platt.

No further experiments appear to have been made in this direction for nearly two centuries, when on Dec. 16, 1799, John Frederic Chabannes obtained an English patent for separating the large coal from the small coal, by passing the latter through sieves or gratings, made of wood or metal, and then consolidating the small coal by mixing it with clay, cow-dung, tar, pitch, &c., to be mixed together and ground with a wheel in water, in a wooden vessel. This mixture he afterwards placed in pits, provided with drains for the water to run off, and then, when almost dry, moulded the mass into cakes of a considerable size.

Since 1799, clay, conjointly with various resinous cements, has been used and patented in European countries by a number of so-called inventors. Among the most prominent were Levy, Stafford, Oram, Goodwin, Drouet, De la Chabeaussiere, Geary, Mohum, Stirling, Dominick, Holcombe, Smith, Hollands, Whitaker, and others. The clay was added to the mixture in order to counterbalance, by its tendency to contract when heated, the tendency of the resinous materials to expand. The resinous materials were added to the clay to make the fuel manufactured burn better and to render it impervious to moisture. The admixture of resinous materials with the small coal and the clay spoiled the fuel by the bad odour and smoke which it made while burning, and at the same time increased considerably the cost of manufacturing solid coal from slack.

While the inventors were trying to find some kind of cement which would hold the particles of coal firmly together until entirely consumed, without emitting smoke or odour, the people in the mining regions of England, France, Germany, and Belgium, feeling the need of a cheap and lasting fuel, were buying the small coal at the collieries, and adding to it from 30 to 40 per cent of clay, with sufficient water to moisten the mixture, worked it into a pasty mass with shovels, and by trampling upon it with wooden shoes. (In some parts of Germany it is trampled upon by men on horseback.) This pasty mass was simply pressed by hand in the shape of balls or eggs, dried in the sun, and stored under shelter until used.

It will easily be perceived that such an addition of clay increases considerably the quantity of ashes and reduces the combustible character of the coal. For the last few years it has been manufactured mechanically, and the proportion of clay has been reduced in Belgium to 20 per cent.

The only objection made to the clay process in the article referred to is, that "it must prove unsuccessful, from the fact that the combustible character of the coal waste is so considerably reduced by the mixture with it of from 10 to 20 per cent of non-combustible materials, that the product can only be burned with difficulty, necessitating either constant attention or an artificial draught." This objection is well founded when applied to even the most improved European methods, but it loses its force when applied to my process, by which the proportion of clay is reduced to 5 per cent, and the fuel manufactured rendered impervious to moisture by an outside coating, thus preventing its gradual deterioration in heating qualities when exposed to the combined action of air and moisture. It will be conceded that 5 per cent. of clay in the fuel is less objectionable than the presence of from 5 to 10 per cent of slate, and sometimes more. If the intensity of heat given by artificial fuel made with clay is not equal to that of the ordinary coal, it lasts longer

and it may safely be asked, if for domestic purposes, this will not be an advantage rather than a defect.

As before stated, clay, as a cement, can be applied to anthracite as well as to bituminous slack; the European factories demonstrate this to evidence. It only requires appropriate machinery to demonstrate the fact in this country.

Before concluding this article, I wish to say that, in my opinion, the manufacture of artificial fuel from bituminous slack and clay is destined to revolutionise the manufacture of iron in the bituminous coal regions. No bituminous coal, except the block coal used in the Brazil furnaces, in Indiana, can be used for smelting, without being previously coked. It is coked for two reasons: 1st. For the purpose of converting it into a fuel deprived of its volatile constituents, which does not become pasty when ignited, and does not run and cake together. 2nd. For the purpose of eliminating from the coal a portion of the sulphur contained as pyrites. Now, it is a well known fact that the slack or coal dust contains a very small proportion of sulphur, hardly any. Scientists and practical metallurgists almost unanimously agree that the sulphur contained in the coal combines with the iron in the furnace only at a low red heat, and it may safely be asserted that the small proportion of sulphur contained in the artificial fuel would be eliminated and the coal coked in the furnace before this combination could take place.

Basing my statements on experiments, I will add that bituminous slack, mixed with clay and moulded into lumps, will not run and cake together; that its tendency to expand will be counterbalanced by the tendency of the clay to contract, and that in any kind of heating apparatus, stove, grate, or furnace, it will coke gradually from the outside surface to the centre, each lump becoming, so to say, a small retort, the gases escaping through a heated surface and being consumed, instead of escaping into the flue; the coal throwing no sparks from the grates and emitting a light, greyish smoke, instead of the black, dense smoke peculiar to the bituminous coal.—*Engineering and Mining Journal.*

ON A

NEW ANGLE-MEASURER AND PROTRACTOR FOR FACILITATING THE PROCESSES OF FIELD SKETCHING AND SURVEYING.*

By W. H. COLLINS, Lieut. R.E., F.R.A.S.

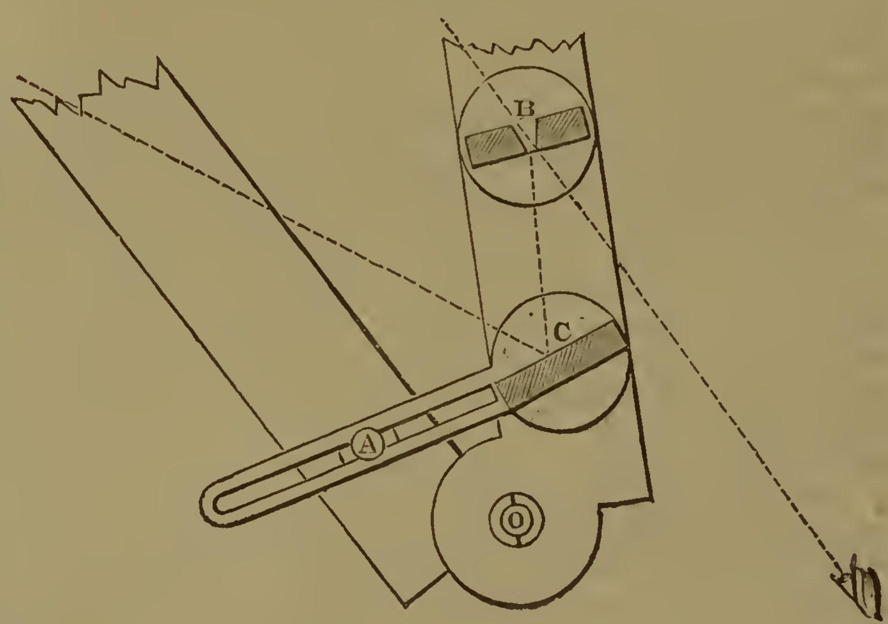
The figure represents an instrument which I am desirous of submitting to the notice of the members of the Royal Dublin Society. This instrument has been designed by me to facilitate the operation of field sketching and military reconnoissance.

Land surveys of large extent are based upon *angular* measurement; a short distance only is measured, and the longer distances are inferred by calculation. In surveys of small extent, all measurement is linear, and the areas enclosed by any assigned figure, bounded by straight lines, can be easily estimated, but such procedure ceases to be possible where the boundary lines are long, or the tract to be covered by the survey is large. With surveys pretending to much accuracy, the angular measurement must be made the basis of trigonometrical calculation, the calculated distances containing the error of the original line in an increased proportion.

When it is unnecessary to obtain great accuracy, the angles ascertained may be plotted upon paper, and the loci of points determined, the intersections of such loci defining the position of remote points.

This latter procedure is that of necessity adopted in military reconnoissances and other cases, where the work must be rapidly executed and extreme accuracy is not necessary. The instruments usually made use of are the pocket sextant and the prismatic compass; the first is accurate, though inconvenient, and the latter convenient, though inaccurate. The instrument proposed by me as a substitute for both sextant and compass is a reflecting instrument, so contrived as to *exhibit* the angle subtended at the eye by two objects.

Reflecting angle-measuring instruments are based upon the fact that the angle through which a mirror is turned is a measure of the angle through which a ray of light reflected by it is displaced—the former being half the latter. In the sextant, an index arm is attached to the reflector, and made to traverse a graduated arc. This arc is divided so as to contain twice the number of degrees that it really holds, and, consequently, any angle read off represents twice the angle through which the mirror has been turned, or the angle between the two positions of the reflected ray. The graduations of the arc are necessarily crowded together, each 30′ representing 1°, 1° representing 2°, &c. The difficulty of reading the angle is increased, while the accuracy of the reading is diminished. In field sketching, such as that referred to above, where angles are plotted upon paper and are not used as the basis of calculation, the value of the angles in degrees and minutes is not required, inasmuch as no use would be made of such values beyond the arriving at the position



Points A and C equidistant from O, the centre of pivot; the mirror, B, is parallel with C when the instrument is closed.

of a line on the paper. The reading of the angle by a microscope and vernier becomes an inconvenient step, and one gladly to be dispensed with if possible. The protactor, also, with which the angle would be plotted, does not read within 30′, while the vernier reads to a second.

Under these circumstances it appeared desirable to produce an instrument which would exhibit in itself the angle subtended at the eye by two points, and allow it to be plotted at once, and thus remove the necessity for intermediate operations. Such an instrument is that represented by the figure. It becomes necessary to contrive two angular motions depending upon each other, one half the other. If a reflector moved with the first, the second would represent the movement of the reflected ray. Cog-wheels were the first expedient that suggested itself to procure such a motion, but these were abandoned for what appeared more desirable, viz., the geometrical necessity of some figure. That of which I have availed myself is this—that the base of an isosceles triangle moves with half the angular motion of one of its sides, the other remaining fixed, and the angle of the vertex being supposed to expand. After much adaptation and alteration, the instrument took the form shown in the figure. The centre of the sector is made the centre of the isosceles triangle, at the extremity of one leg of which is the centre of the index mirror, at the extremity of the other the centre of

* A paper read before the Royal Dublin Society.

the movable spud, A, which slides between two guides upon the base.

The operation of the instrument is obvious on looking at the figure. When the legs are closed the two mirrors are parallel, and the object seen *direct* over the smaller mirror is seen also reflected in it. On opening the instrument, other objects are seen reflected in the small mirror, and the angle exhibited by the legs is that subtended at the centre of the movable mirror by the two objects, seen one direct, and the other by reflection immediately below. The pivot is pierced with a small hole, to allow the paper to be seen through, and to allow a pencil-mark to be made. The right-hand object is looked at, and reflected image of the left-hand object made to appear below it in the small glass.

This instrument has been tested both with a theodolite and quadrant, and the angles in each case plotted upon paper; the results were identical.

BEHAVIOUR OF ETHER WHEN IN CONTACT WITH OTHER SUBSTANCES.

By A. LIEBEN.

IN my treatise on "The Origin and Production of Iodoform and on the Application of these Reactions" (*Ann. d. Chem. u. Pharm.*, *Supplm.* 7, p. 221), I have said that when ether is shaken up with water and the water then treated with iodine and potassa no iodoform is formed, if the ether is perfectly pure; but I also observed that it was difficult to obtain pure ether, since the simple contact of ether with water, even at the ordinary temperature, and far more rapidly at 100°, causes the ether to become contaminated with alcohol. I have further investigated this subject by first trying whether perfectly pure ether, when kept alone, remains unaltered, and also, whether contact with water always produces alteration; while I lastly tried the effect of substances usually employed for drying ether. This research appeared to me to be the more interesting, since the high sensitiveness of the iodoform reaction affords a means of detecting slight alterations. When a compound so fixed and stable as ether is subject to changes hitherto scarcely thought of, it seems reasonable to conclude that other substances also undergo alterations, which are not detected for want of reagents.

Ether by Itself.—I have in another paper described the methods of making perfectly pure ether; I only mention here that it is best to re-distil the ether so obtained once or twice over sodium, chloride of calcium tubes being fitted to the distilling apparatus to avoid the contact of moist air. Ether so purified, and kept in well-stoppered bottles, continues good for several months; even after fifteen months no iodoform reaction was exhibited, and I therefore conclude that pure ether kept as stated does not become altered, at all events not sufficient to be detected by the iodoform reaction.

Ether with Water.—I repeated my former experiments by pouring ether and water or ether and dilute sulphuric acid in glass tubes, and after sealing I heated these tubes for twenty-four hours to 100°; on testing the water afterwards I detected a strong reaction of iodoform, due to formation of alcohol, while, on the other hand, a sealed tube, also containing water and ether, kept during the same period of time at the ordinary temperature, did not exhibit this reaction. I also found by separate experiments that when the sealing of the glass tubes is carefully proceeded with there is no chance that any iodoform-producing substance (aldehyde, for instance, due to the action of the red-hot glass on the vapour of ether) can be generated; it is therefore quite certain that when ether and water are heated to 100° alcohol is in a short time formed. The same action between ether and water obtains at the ordinary temperature, but only after the lapse of a considerable time; ether kept with water in well-stoppered bottles exhibited the iodoform reaction after some three or four months, but in some instances the reaction was obtained in a shorter time. Both the ether and water were pure.

Ether and Sodium.—Pure ether kept in contact with small lumps of sodium in a well-stoppered bottle was found after six months to exhibit no iodoform reaction.

Ether and Chloride of Calcium.—Pure ether kept with lumps of freshly-ignited chloride of calcium in a well-stoppered bottle for a period of six months was found on being tested to distinctly exhibit the iodoform reaction, and consequently the ether had undergone alteration.

Ether and Caustic Potassa.—Pure ether and freshly-prepared fused caustic potassa kept for six months was found to be unaltered; and the same result was obtained when the ether was kept for the same lapse of time with recently burnt caustic lime. When the pure ether was kept for six months along with freshly-ignited chloride of sodium it exhibited a distinct iodoform reaction, but with freshly-ignited carbonate of potassa no such reaction was obtained after the same lapse of time.

Ether and Anhydrous Sulphate of Copper.—When sharply dried (dehydrated) sulphate of copper and pure ether are kept for six months in a well-stoppered bottle the ether exhibits no physical appearance of change, but on testing the ether it exhibits distinctly the iodoform reaction. A portion of the same ether employed in these experiments was kept alone, and having been tested after six months did not then exhibit any trace even of formation of iodoform. I cannot explain the reason why certain neutral and anhydrous substances ($CaCl_2$, NaCl, $CuSO_4$) should have any peculiar effect on ether without entering into hypotheses which are not proved; it appears that basic substances do not act upon ether, while acids and salts affect it. We might suppose that ethylates are formed, for instance:—

$$CuSO_4 + C_2H_5OC_2H_5 = Cu\begin{matrix} -OC_2H_5 \\ -O-SO_2-OC_2H_5, \end{matrix}$$

and that by the operation of testing for iodoform alcohol is formed by the action of water; but it is also possible that a small portion of the ether is converted into alcohol and ethylen. The main point of interest in these researches is that perfectly pure ether can be kept by itself in well-stoppered bottles without alteration, and also when in contact with perfectly dry and previously thoroughly ignited KHO, $CaOK_2CO_3$, and also with pure sodium, but the ether cannot be kept with water, $CaCl_2$, NaCl, or $CuSO_4$, because when in contact with these substances it is gradually altered.—*Annalen der Chemie und Pharmacie.*

SUINT.

IN nothing is the spirit of the age more clearly shown than in the efforts made to utilise waste substances. This is being done with such effect that what was formerly got rid of with great difficulty and at considerable expense may become one of the most important objects of manufacture. We need only point to such matters as sewage, the slag of furnaces, the fine coal of commerce, the waste of pyrites used in the manufacture of sulphuric acid, &c., as illustrations. Quite a recent instance of this improved economy is found in the treatment of the wool of sheep. It has been ascertained that sheep derive from the soil upon which they pasture a considerable amount of potash, which, after it has circulated in the blood, is excreted from the skin with the sweat, and remains, generally in connection with this, attached to the wool. Chevreul discovered, some time ago, that this peculiar mixture, known by the French as suint, constitutes not less than one-third the weight of the raw merino fleece, from which it is easily removed by immersion in cold water. In ordinary wools the suint is less, the amount being about 15 per cent of the raw fleece. Formerly it was

considered as a kind of soap, mainly for the reason that the wool, besides this, sometimes contained about 8 per cent, or a not inconsiderable quantity of fat.. This fat, however, is usually combined with earthy matters, mostly with lime, and consequently forms a soap which is very insoluble. The soluble suint is a neutral salt arising from the combination of potash with a peculiar animal acid, of which little more is known than that it contains saltpetre. Special effort has lately been directed to suint, in order to obtain as much as possible of the potash eliminated from the animal, and a special industry has been established in various portions of the great French wool district, such as Rheims, El Bœuf, &c.

A company purchases from the wool raiser the solution of the suint obtained by rinsing the wool in cold water, the price paid for it being higher in proportion as it is more concentrated. As a general thing it is maintained that a fleece weighing nine pounds contains about 20 ounces of suint, which should contain about one-third part, or six to seven ounces, of potash, although not more than five and one-half ounces are perhaps directly available.

In the wool manufactories of the towns just referred to, there are nearly 60,000.000 pounds of wool washed annually, the yield of about 6,750,000 sheep. This quantity should contain over 3,000,000 pounds of pure potash. Thus, the water in which the wool is washed, and which has been heretofore thrown away, is made to yield a product, adding appreciably to the value of the wool itself, and more than covering the cost of its treatment. It is, of course, not an easy matter to utilise this solution of suint on a small scale; but wherever the work is carried on by the wholesale, as it is in connection with all great manufacturing establishments, it will undoubtedly become a regular part of the process of manufacture.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 16th, 1872.

Professor Frankland, D.C.L., F.R.S., President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, Messrs. Philip Braham, A. Percy Smith, and J. Wills were formally admitted Fellows of the Society.

The names of Messrs. Edward Dillon, J. Perry, G. Brownen, T. W. Sheppard, T. C. Sellars, H. Y. Loram, and W. Sharpleigh were read for the first time; and those of Messrs. George Washington Arnott, James Scott McGregor, and Cornelius A. Mahoney were read for the third time, after which these gentlemen were balloted for, and duly elected Fellows of the Society.

The first paper, entitled "*Notes on Various Chemical Reactions*," by Mr. Davies, was then read by the Secretary.

The first note was on the *Formation of Crystallised Copper Sulphide.* The author found that, when copper is covered with a layer of carbon disulphide, and a layer of ammonia is superposed, that the metal becomes covered with beautiful green crystals of copper sulphide in the course of a few days.

In the second note, on *Bromised Hypochlorite of Lime*, the author remarks that a solution of hypochlorite of lime, to which bromine has been added, may be advantageously employed, in the place of hypochlorite of lime, for the precipitation of cobalt from a solution containing this metal together with nickel. The precipitation does not take place instantaneously, heat being necessary to produce the reaction.

The third note was on *Barium Bisulphide.* It was found possible to obtain this substance as a fine yellow-coloured product by shaking a solution of barium chloride with a mixture of ammonium sulphide and carbon disulphide. It is insoluble in alcohol, soluble in water, and rapidly dissolved by slightly acidulated water.

The Secretary then read the second paper, entitled "*On Ethyl-Amyl*," by Harry Grimshaw. The ethyl-amyl employed in this research was obtained by submitting a mixture of ethyl-bromide and amyl-bromide to the action of sodium, it being found that the alcoholic bromides were well adapted for this purpose, the yield of hydrocarbon being highly satisfactory. By fractionating the product, ethyl-amyl, boiling at 90°, was obtained. It was converted by chlorine into a chloride, $C_7H_{15}Cl$, boiling between 140° and 150°, and this, when treated with potassium acetate and glacial acetic acid, yielded the corresponding acetate, accompanied by a certain quantity of heptylene boiling at 91°. The acetate, on treatment with alcoholic potash, gave a mixture of alcohols which, on oxidation, yielded an acid whose silver salt had the composition $C_7H_{13}AgO_2$, and a ketone, $C_7H_{14}O$, boiling at 144°, which yielded, on oxidation, a mixture of valerianic acid and acetic acid. The author considers that the mixture of alcohols consists of primary isoheptyl alcohol and methyl-amyl-carbinol, the former yielding, on oxidation, iso-œnanthylic acid, $C_7H_{13}HO_2$, and the latter yielding Popoff's ketone, $C_7H_{14}O$, which, by further oxidation, yields valerianic and acetic acids. These researches point to the conclusion that ethyl-amyl is dimethyl-butylene-methane.

The President, after expressing the thanks of the Society for this communication, remarked that the present investigation was characterised by a singular thoroughness, and it might well be taken as a model by other investigators. He was struck by the success with which the author had employed bromides in the place of iodides; also by the large yield of hydrocarbons which had been obtained, notwithstanding the fact that the use of sodium has generally a tendency to increase the amount of secondary products in reductions of this kind.

A paper on "*The Heptanes from Petroleum*," by Dr. C. Schorlemmer, F.R.S., was then read by the Secretary.

In a previous paper the author alluded to a hydrocarbon, having the composition C_7H_{16}, and boiling at about 90°, which was obtained from Pennsylvanian petroleum. Thinking it probable that this might be identical with ethylamyl, he submitted it to a new examination. The boiling-points of several of its derivatives were found to correspond with those of ethylamyl, and the oxidation of its alcohol gave rise to an acid very similar to the corresponding acid from ethylamyl; also to a ketone boiling at 144°, but which, unlike that derived from ethylamyl, yielded nothing but acetic acid on oxidation. Hence it is certain that this hydrocarbon is not identical with ethylamyl. Its constitution and that of the ketone obtained from it will form the subject of future investigations. The author is, however, inclined to regard it as dimethyl-diethyl-methane. During the conversion of the chlorides from normal heptane into acetates a portion of heptene (heptylene), boiling at 98° to 99°, was formed. About half of this combined with cold hydrochloric acid, while the remaining portion did not unite with this acid until heat was applied. The two isomeric chlorides thus separated were re-converted into olefines, both of which boiled at 98°. When heptene, boiling at 90° to 91°, is treated with cold hydrochloric acid the greater portion dissolves, while not much more than half of the heptene prepared from ethylamyl combines in the cold with this acid, a heptyl chloride, boiling at 134° to 137°, being formed.

The President, in returning thanks, remarked that this interesting paper was a new proof of Dr. Schorlemmer's success in the investigation of very complex hydro-carbons. The new method of separating the isomeric ole-

fines being likely to be of great service to future investigators.

A paper on "*The Vanadates of Thallium*," by THOMAS CARNELLEY, was then read by the Secretary. In this paper the following salts are described:—Thallium orthovanadate, Tl_3VO_4, or tetravanadate, $Tl_{12}V_4O_{16}$; thallium pyrovanadate, TlV_2O_7, or hexavanadate, $Tl_{12}V_6O_{21}$; Beta thallium vanadate or orthovanadate, $Tl_{12}V_5O_{26}$; Gamma thallium vanadate or decavanadate, $Tl_{12}V_{10}O_{37}$; thallium metavanadate, $TlVO_3$, or do-decavanadate, $Tl_{12}V_{12}O_{36}$; and Delta thallium vanadate or tetrakaidecavanadate, $Tl_{12}V_{14}O_{41}$. These salts were obtained either by precipitation or by fusing thallium carbonate with the requisite amount of vanadic anhydride, or of one of the salts already formed. They form in most instances yellowish precipitates, or reddish brown fused masses. *Beta silver vanadate or octovanadate*, $Ag_{12}V_8O_{26}$, was obtained as a dark yellow dense precipitate by adding silver nitrate to a solution of the salt, $Na_{12}V_8O_{26}+12H_2O$; this salt, *Beta sodium vanadate or octovanadate*, being obtained by fusing together the requisite proportions of sodium carbonate and vanadic anhydride. It is soluble in water, but does not crystallise readily.

The PRESIDENT remarked that these researches were interesting, as they illustrate the analogy existing between the vanadates and the phosphates.

A communication, by T. KINGZETT, on "*The Formation of Disodic Sulphide by the Action of Dihydric Sulphide upon Sodic Chloride at High Temperatures*," was then read. The author finds that when coal gas containing hydrosulphuric acid, or this gas in a pure state, is passed over sodium chloride heated to redness, a considerable portion of the salt is decomposed, the product being sodium sulphide. After thanking the author for this communication, the President observed that it would be of considerable interest to determine the exact amount of sodium sulphide formed under given physical conditions.

Mr. P. BRAHAM then exhibited the apparatus which he has devised for the prosecution of physical research under the microscope. Arrangements were made for observing the behaviour of bodies when placed in different positions with regard to the magnetic field, and when submitted to the influence of the induction spark at various pressures. Mr. Braham made some remarks on the appearances presented when the spark leaves the conducting wire and passes through rarefied air; this latter appearing, under some circumstances, to be a better conductor than silver. This phenomenon only takes place when there is a break in some part of the circuit.

After expressing a hope that the author would soon communicate to the Society some of the results obtained with his apparatus, the PRESIDENT announced that the meeting would then adjourn till Thursday, February 6, when the following papers will be read:—"*On Anthrapurpurin*," by W. H. Perkin; "*On the Solidification of Nitrous Oxide*," by T. Wills; and on "*Isomerism in the Terpene Family*," by Dr. C. R. A. Wright.

NOTICES OF BOOKS.

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. (Lond.) Vol. LXVI., July to December, 1872. London: Simpkin and Marshall.

A USEFUL summary of the progress of the medical sciences during the last six months. As matters falling more especially within our sphere we notice Dr. Richardson's new anæsthetic, a mixture of ether and methylene, and Dr. Seegen's method of detecting sugar in urine by filtration over animal charcoal before the application of Trommer's test, which without this precaution is deceptive. A process is recommended for detecting nitrogenous substances in drinking-waters. The sample is concentrated to one-eighth its bulk, without boiling. The residue is mixed when cold with its own volume of concentrated sulphuric acid. When cold a strong solution of green vitriol is carefully added, so as to float upon the surface of the mixture, when the presence of nitrogen is shown by a dark line at the junction of the two liquids. We must caution persons using this test to ascertain first the absence of nitrogenous compounds in the sulphuric acid, or they will be deceived.

CORRESPONDENCE.

THE ESTIMATION OF SULPHUR IN PYRITES.

To the Editor of the Chemical News.

SIR,—Allow me to reply to the letter of "Experience" in the CHEMICAL NEWS, vol. xxvii., p. 33. He says "he cannot see that my paper is a very valuable contribution to our knowledge on the estimation of sulphur in pyrites." . . . . "And that anyone having had much experience with the estimation of sulphur in pyrites would never resort to the incorrect method of fusion." "Experience" is probably unaware that there are chemists who employ both the fusion and the acid processes, in conjunction, however, with titration by barium chloride.

"Experience" "would prefer the fusion process in platinum crucibles to all others if it gave correct results," and asks me to describe the method by which I get such good results. My article answers this question, and is on that account, perhaps, a valuable contribution to the knowledge of "Experience" himself, since it enables him to work the fusion method with better results.

At the conclusion of his letter, the writer speaks of the purification of the barium precipitate; if he will refer to my article he will see that I am dealing with a volumetric, and not a gravimetric, process. In the single gravimetric experiment given, the precipitate was not purified; the correctness of the result is therefore possibly accidental. I am aware that the sulphur is found to be higher in the fusion than in the acid process, where the fusion is made in a crucible.

In 1864, Dr. David Price called attention to the fact that a not inconsiderable amount of sulphur is found in a simple fusion of alkalies in a crucible over a gas-flame; this, however, was only the case when the mixture crept over the sides of the crucible. In his experiments, three-quarters of an hour's heating was sufficient to give an appreciable amount of sulphur. This observation will scarcely account for half a per cent of sulphur above that found by the acid process.—I am, &c.,

PHILIP HOLLAND.

MISCELLANEOUS.

London International Exhibition, 1873.—The third meeting of the Committee on Surgical Instruments and Appliances was held on Monday afternoon at the offices, Gore Lodge, and the following members were present:—Mr. Cæsar H. Hawkins, F.R.S. (in the chair), Dr. P. Allen, Mr. R. Brudenell Carter, Mr. W. White Cooper, Sir W. Fergusson, Bart., F.R.S., Dr. Arthur Farre, F.R.S., Dr. G. T. Gream, Mr. Prescott Hewett, Mr. J. Hinton, Mr. J. Luke, F.R.S., Mr. T. W. Nunn, Dr. W. S. Playfair, Mr. Edwin Saunders, and Mr. Edwin Sercomb. Major-General Scott, C.B., Secretary to Her Majesty's Commissioners, attended the meeting. The Committee considered the following resolutions, which were passed at a meeting of London surgical instrument manufacturers held on the 10th inst., Mr. Louis Blaise in the chair:—"(1) That the surgical instrument manufacturers do not exhibit unless the conditions regarding their manufactures to be submitted to a Committee of Selection be withdrawn;

(2) that they may exhibit all the articles of their manufacture as a whole, and not in sections or subdivisions as proposed by Her Majesty's Commissioners; (3) that the conditions upon which the foreigner and Englishman exhibit shall be one and the same." It was recommended that a reply should be sent, explaining that English and foreign exhibitors would, as always intended, be on precisely the same footing; that it is not proposed to separate an exhibitor's instruments into sections or subdivisions; and that, while it is unadvisable to dispense generally with the principle of acceptance on the approval of a committee, an assurance of admission might be given by the Committee to manufacturers of very high repute who should notify their desire to exhibit. The Committee was informed that Signor A. Castellani, of Rome, had commenced to make exact reproductions of the surgical instruments found at Pompeii, and that the Japanese minister, Terashima Munerero, himself a physician, had promised to obtain a collection of surgical instruments from Japan. Letters were read from Sir Alexander Armstrong, K.C.B., Sir John Rose Cormack, M.D., of Paris, the Royal College of Surgeons, the Royal College of Physicians, University College, and the University of Edinburgh. The Committee then adjourned till Monday, February 17.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 13, 1873.

This number contains the following original papers and memoirs relating to chemistry:—

Researches on the Allotropic Transformations of Phosphorus.—L. Troost and P. Hautefeuille. The contents of this essay record some calorimetric measures and experiments made with the view to explain the calorific phenomena which accompany the formation of the allotropic modifications of some substances.

New Process of Steel-Making.—F. Bajault and M. Roche.—The authors describe a process based upon the decarburation of pig-iron when intimately mixed with some rich iron ores, and kept fused in crucibles or reverberatory furnaces for some time. A specimen of steel thus made was, on analysis, found to contain, in 100 parts:—Combined carbon, 0·43; non-combined carbon, 0·080; silicium, 0·23; phosphorus and sulphur, none. The steel thus prepared is malleable, strong, and becomes hard by annealing.

Sulphurous and Chlorosulphuric Acids—Combination of Chlorine and Hydrogen in Complete Darkness.—Professor Melsens.—This lengthy essay treats, in the first place, on the preparation of pure and dry sulphurous acid gas, which the author states is best obtained by causing strong sulphuric acid at a high temperature to act upon sulphur. Chlorosulphuric acid, SO_5Cl, is readily obtained by passing chlorine and sulphurous acid gas into strong acetic acid. The author further describes at length a series of experiments, the result of which is, that properly prepared charcoal may be made to absorb its own weight of chlorine; when such charcoal is placed in a vessel filled with hydrogen, hydrochloric acid is formed, while the temperature of the vessel and contents becomes considerably lower. The chlorine-containing charcoal decomposes water at the ordinary temperature, with formation of hydrochloric and carbonic acids.

Statics of Saline Solutions.—Dr. Berthelot.—From his thermochemical researches, the author concludes that, when strong acids and strong bases are together present in a solution, the stronger acids combine with the stronger bases, and the weaker acids with the weaker bases.

Polypropylenic Carburets.—M. Prunier.—This essay treats on the formation of certain hydrocarbons, by the reduction of bromide of propylen by means of nascent hydrogen. The hydrocarbon obtained by the author is probably a dipropylen, $(C_6H_6)_2$; it boils at 70°.

Anti-Ferment Properties of Silicate of Soda.—M. Picot.—This exhaustive essay treats on the physiological action of silicate of soda. It appears, from the author's researches, that the silicate is not only an anti-ferment, but that it is actually a poison, since it destroys the blood globules, and kills by causing asphyxia.

Memoir on Chlorophyll.—A. Millardet.—The author refers first to Chautard's last paper on this subject, and then states that he has found chlorophyll unaltered in the animal organism, and that certain insects which feed on leaves owe their green colour to this substance.

Analysis of the Lanarkite of Leadhills.—F. Pisani.—It appears from this exhaustive essay that, according to some of the older analyses, lanarkite contains some carbonate of lead, and is readily soluble in nitric acid. The author has tested a large number of samples of this mineral kept in different museums, and he has found none containing carbonic acid. According to his analysis, lanarkite consists, in 100 parts, of—Oxide of lead, 82·73; sulphuric acid, 15·10; loss by heat, 0·83; total, 98·66. Formula, $\dot{P}b_2\dddot{S}$; that is, a basic sulphate of lead.

Use of Gas for the purpose of Producing a High Temperature.—L. Forquignon and A. Leclerc.—The detailed description of a contrivance by means of which a high temperature may be readily produced, regulated, and maintained.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 20, 1872.

The following original memoirs and papers are published in this number:—

Synthesis of Phenyl-Butylen.—B. Aronheim.—After briefly referring to some unsuccessful experiments made in the direction alluded to, viz., the synthesis of hydrocarbons of the C_6H_5— — C_nH_{2n-1} series by the reaction of sodium upon the halogen combinations of the corresponding alcohol radicals, the author describes at length his researches, made with the view of preparing, synthetically, phenyl-butylen by the reaction produced in mixture of the proper atomical quantities of benzyl-chloride and iodallyl in ether by metallic sodium in excess. The result of this operation gave, in addition to some other substances, phenyl-butylen, $C_{10}H_{12}$; boiling-point, 176° to 178°; vapour density, 132; sp. gr. at 15·5°=0·9015; formula of formation—

$$C_6H_5.CH_2Cl+CH_2 =:= CH-\,-CH_3I+Na_2=$$
$$=C_6H_5-\,-CH_2-\,-CH_2-\,-CH =:= CH_2+NaCl+NaI.$$

New Synthesis of Anthracen.—W. A. Van Dorp.—In the first part of this essay, the author discusses at length the nature of a fluid hydrocarbon which appears to be met with in crude anthracen, and which has been stated by various authors to be dibenzyl, or isomeric with ditolyl or benzyl-toluol. In the next part, the author describes at length, and elucidates by complex formulæ, the synthetical formation of anthracen from benzyl-toluol (prepared in pure state), by passing the vapours of that hydrocarbon through a red-hot porcelain tube filled with lumps of pumice-stone. The anthracen is thus readily obtained pure, although the quantity is small. An oily compound is also given off, which again yields anthracen by the same treatment.

Preliminary Notice.—R. E. Meyer.—This essay, elucidated by a series of lengthy and complex formulæ, treats on a general method of the formation of keton acids by the aid of ethyl-oxalic acid salt (*aethyl-oxalsauren salze*).

Composition of Suint.—E. Schulze.—After referring to researches on this subject made by Hartmann and himself, the author states that, when suint (the fatty matter present in crude wool) is treated with boiling-hot alcohol, it yields cholesterine, partly soluble in the boiling alcohol; and the portion which is insoluble therein is found to consist partly of the same fatty substance, and partly of benzoic acid-cholesterine-ether; the methods of separating these bodies are referred to at length. It appears that the composition of suint is rather complex, because acetic acid-cholesterine-ether seems also to be present therein.

Lecture Experiments made with the Thermo-Analysator.—E. Mulder.—The detailed account, illustrated by a woodcut exhibiting the apparatus just named, of some experiments made by the author for exhibiting the decomposition, by the aid of heat, of various substances, such as hydrochloric acid gas, phosphuretted hydrogen, &c.

Action of Zinc-Ethyl upon Silicic Acid-Methyl-Ether.—A. Ladenburg.—This essay records at great length the results of the reaction just named; but, aided by sodium, the new substance thus formed is termed by the author ortho-silico-propionic acid-methyl-ether (*ortho-silico-propion-saure-methyl-ether*). Formula, $SiC_2H_5(OCH_3)_3$; sp. gr. at 0°=0·9747; insoluble in water, but miscible with alcohol and ether. Some of the reactions of this ether with other substances are alluded to, and general directions given for the preparation of homologues of the silico-propionic acid.

Effects of Alcohol upon Animal Heat.—C. Binz.—A physiologico-thermical essay.

Toluol-Disulpho Acid.—C. W. Blomstrand.—An exhaustive monograph, elucidated by several tables, not well suited for abstraction.

On Pentabrom-Resorcin.—C. Liebermann and A. Dittler.—This essay treats on the formula of pentabrom-resorcin, and on the question whether the body is, or is not, an addition product. This paper is elucidated by a series of complex formulæ.

Contribution to our Knowledge of the History of the Azo-Compounds.—K. Heumann.—The author criticises Alexejeff's paper on this subject (see Chemical News, vol. xxvii., p. 22), and proves that he (the author) long since discovered and described several of the bodies which Alexejeff claims to have first made known.

Combinations of Aldehyde and Phenols and Aromatic Hydrocarbons.—A. Baeyer.—This monograph is divided into the following sections:—Formaldehyde and phenol; formaldehyde and pyrogallic acid, and gallic acid and benzol and mesitylen; chloral and benzol.

This number contains a condensed report of the proceedings of the meetings of the Imperial Russian Chemical Society at St. Petersburg, and also the report of the proceedings of the general annual meeting of the German Chemical Society at Berlin. As regards the former, the papers will be published *in extenso* in German periodicals. From the latter, we are glad to find that the Society is in a flourishing state; on the 14th of December last the number of members amounted to 822. At the request of many of the most prominent chemical manufacturers the North German Confederation has appointed a provisional committee to report on the chemical industries represented at the forthcoming Vienna Exhibition. We may also mention that the Municipal Government of Oranienburg (near Berlin) has agreed that the Runge memorial monument, placed in the cemetery of that town at the expense of some of the deceased's personal friends and the members of this Society, shall be properly taken care of.

Les Mondes, January 9, 1873.

Cerealine and Corn Phosphates.—MM. Devaux.—The authors have succeeded in extracting, from previously decorticated wheat, that highly-nitrogenised portion containing phosphoric acid which forms a thin, but compact, layer just inside the husk, and which, by the ordinary method of grinding wheat, is almost lost with the bran. This material, to which the name of cerealine is given, also contains a peculiar principle, in small quantity, which highly stimulates digestion. Mixed with sugar and pure powdered chocolate, it appears to be highly valued as an analeptic by the faculty in Paris.

Method of Rendering Petroleum (Paraffin Oil) thick, so as to Prevent its Danger of Causing Fire.—M. Jordery.—By means of an inert substance (the powder of *saponaria*, a vegetable material), the author renders petroleum as thick as a sauce, so as to prevent its danger owing to its fluidity, and yet not interfering with its properties; because the thickened oil may be at once rendered fluid again by the addition of a few drops of phenic or strong acetic acids.

Newly-Devised Geodesical Instrument.—Dr. La Porte.

Technical Russian Society, Section Kieff.—This institution intends to award a prize for the best essay giving a simple and rapid, as well as readily executable, method of estimating the saccharine value of beet-roots. The process should be free from the inconveniences attending the processes now known. Memoirs to be sent in on or before the 13th of September next, to M. Tschoubinski, Goroditsch Sugar Works, Spola, district of Kieff (Kiew), Russia.

Although not belonging to chemistry or collateral subjects, we call attention to the two following important papers:—

Effects Produced by the Construction of the Mont Cenis Tunnel and the Suez Canal.—Baron E. Du Menil.

Earthworms.—Dr. E. Robert.—This essay contains curious observations on the utility of worms to agriculture and horticulture.

January 16, 1873.

Bibliography.—Under this heading attention is called to the following work:—"Climat, Géologie, Faune, et Géographie Botanique du Brésil," par M. Emmanuel Liais. This work, published by the Imperial Brazilian Government, contains correct and highly interesting information on Brazil. The author, a Frenchman, has thoroughly surveyed and explored this large empire, and in his work gives a faithful record of its mineral and other resources, as well as of its botanical productions and animals.

Petites Annales de Chimie.—E. J. Maumené.—The tenth part of a monograph. This portion, treating on fermentation without ferments, is elucidated by a large number of algebraico-chemical formulæ, and is, like the former parts, written to thoroughly explain the author's views of the theory of chemistry.

American Journal of Pharmacy, January, 1873.

This number contains the following original matter bearing upon chemistry:—

Solania in Solanum Lycopersicum, the Tomato Plant.—G. W. Kennedy.—The process employed by the author for preparing solania from the fresh leaves and stems of the plant is that of Wackenroder, but substituting ammonia for hydrate of lime. The solania, separated in crystalline state, was found to have a rather nauseous taste. With sulphuric acid, it gives a bright red colour, passing to reddish brown; with iodine, a characteristic yellowish brown colour is produced. The plant further contains some fixed oil, gum, chlorophyll, and inorganic salts.

Ceresine, a Substitute for White Bees'-Wax.—J. P. Remington.—This substance is obtained by heating ozokerite to from 250° to 300° in order to separate some oily fluids. When the mass is cooled down to 60°, it is treated with from 10 to 26 per cent of Nordhausen (fuming) sulphuric acid; the temperature is then raised to 100°, and care is taken to maintain this heat until the precipitation of the carbon takes place and forms a viscous residue, which is separated from the supernatant oils, then treated with 10 per cent of dilute sulphuric acid, and then neutralised by an alkali. The mass is then heated to 180°, poured upon plates, pressed through linen cloths, in order to separate greasy matters, and the residue melted again and filtered. The product is ceresine, a substance apparently holding a middle place between wax and paraffin.

Modified Form of Crystals of Permanganate of Potassium.—J. P. Remington.—The author states that some permanganate imported from Germany was found to be, although otherwise pure, crystallised in a manner resembling a miniature heap of the salt anthracite. The cause of this divergence appears to be due to the presence of some foreign salts in the solution, from which the permanganate crystallised. The author observes that he found once, when preparing a large quantity of the permanganate, that, while the solution contained chloride and sulphate of potassium, there was also formed a double salt of perchlorate and permanganate of potassium.

Adulterated Heavy Magnesia.—R. V. Mattison.—The author details at length his tests of a sample of heavy magnesia found to be adulterated with Rochelle salt. This sample was imported into the United States from abroad.

International Exposition at Philadelphia in 1876.—Under this title, we find a proclamation of Congress to the people of the United States stating that the end of the first centennial of the existence of the Great Transatlantic Republic will be celebrated by a grand International Exhibition, to be held at Philadelphia, and to originate under the auspices of the National Legislature.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 19, 1872.

This number contains no original papers relating to chemistry.

La Revue Scientifique de la France et de l'Etranger, January 11, 1873.

Contains no papers relating to chemistry.

January 18, 1873.

This number contains the continuation of—

Lectures on Practical Agriculture: Receipts for Various Mineral Manures.—G. Ville.—Illustrated with woodcuts and a large number of receipts for mineral manures for different crops.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3194. T. Cobley, Dunstable, Bedfordshire, and J. E. Poynter, Glasgow, N.B., "Improvements in obtaining caustic baryta."—Petition recorded October 28, 1872.

3924. W. McAdam, Glasgow, N.B., "Improvements in utilising waste products of chemical and other works, in order to render the same applicable for building and structural purposes."

3926. D. C. Miller, Lonkhall, Lanarkshire, N.B., "Improvements in distilling, evaporating, or concentrating saccharine and other solutions or liquids."—Petitions recorded December 27, 1872.

3930. B. White and P. T. Hendry, Glasgow, N.B., "Improvements in treating liquids to be burned for illuminating purposes."—A communication from J. Hale, jun., Cincinnati, U.S.A.—Petition recorded December 27, 1872.

3939. R. Williamson and J. Dale, Northwich, Cheshire, "Improvements in the manufacture of salt, and in apparatus employed therein."—Petition recorded December 28, 1872.

3949. J. Higgin, Manchester, and J. Stenhouse, Pentonville, Middlesex, "Improvements in treating waste liquors containing arsenical or phosphatic compounds, and in obtaining and applying useful products therefrom."

3957. J. W. Spencer, Newcastle-on-Tyne, "Improvements in the production of iron."—Petitions recorded December 30, 1872.

3959. J. Harrington, Ryde, Isle of Wight, "Improvements in the treatment of paper and other materials for the production of imitation or artificial leather."—Petition recorded December 31, 1872.

1. C. W. Harrison, High Holborn, Middlesex, "Improvements in treating certain gases for lighting and heating purposes, and in combining atmospheric air therewith."

14. G. Rawle, Bristol, and W. N. Evans, Bedminster, near Bristol, "Improvements in the manufacture of leather."

17. C. Boundy, Birmingham, "Improvements in treating waste products and other materials containing zinc for the purpose of recovering zinc and other valuable products therefrom, and in apparatus to be employed for that purpose."—Petitions recorded January 1, 1873.

38. G. Bischof, Glasgow, N.B., "Improvements in the purification of water, and in the means and apparatus employed for that purpose.

42. W. G. Thompson, Manchester, "An improved process and apparatus for extracting oleaginous or fatty matters from liquid or solid substances."—Petitions recorded January 3, 1873.

45. A. A. Croll, Coleman Street, London, "Improvements in means or apparatus for the distillation of ammoniacal liquors, which improvements are also applicable in the distillation of other liquids, and in the concentration of soluble salts."

50. P. Spence, Newton Heath, Manchester, "Improvements in obtaining valuable substances derivable from residual liquors produced in the manufacture of alum from natural phosphates of alumina."—Petitions recorded January 4, 1873.

68. J. Argall, Adderbury, Oxfordshire, "Improvements in the manufacture of oil paints."—Petition recorded January 7, 1873.

NOTICES TO PROCEED.

2527. C. Frickinger, Berlin, "Improvements in the manufacture of malleable iron, and in the furnaces employed therein."—Petition recorded August 26, 1872.

2569. B. W. Gerland, Ph.D., Macclesfield, Cheshire, and E. Johnson, Dartmouth Park, near Sydenham, Kent, "Improvements in the manufacture of sanitary charcoal, and the application thereof to the treatment of sewage."

2573. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of hydrochloric acid, and in apparatus employed therein."—Petitions recorded August 29, 1872.

2596. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of salt."—Petition recorded August 31, 1872.

2617. F. C. Danvers, Ealing, Middlesex, "Improvements in the manufacture of artificial fuel."

2619. F. R. H. Protheroe, Lydney, Gloucestershire, "Improvements in the manufacture of paper."—Petitions recorded September 3, 1872.

2630. J. W. Pollard, Mincing Lane, J. Schofield, Mark Lane, and A. Butel, Merchant Street, Bow, "Improvements in the treatment of spent oxides of iron, for the purpose of extracting cyanides."—Petition recorded September 4, 1872.

2642. C. W. Torr, Aston, New Birmingham, and J. Johnstone, Birmingham, "Improvements in furnaces for heating and melting metals and metallic alloys."—Petition recorded September 5, 1872.

2648. A. C. Duncan, and A. Duncan, Manchester, "Improvements in the production of Turkey red."—Petition recorded September 6, 1872.

2719. W. R. Lake, Southampton Buildings, London, "An improved process and compound for tempering and refining steel."—A communication from W. N. Severance, South Bend, Indiana, U.S.A. —Petition recorded September 13, 1872.

2822. C. Morfit, Baltimore, Maryland, U.S.A., "Improvements in the reclamation of materials employed in the manufacture of di-phosphate and tri-phosphate of lime."—Petition recorded September 24, 1872.

3180. A. Malam, Dumfries, N.B., "Improvements in the manufacture of illuminating gas, and in apparatus therefor."—Petition recorded October 26, 1872.

3588. A. V. Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of sugar, and in apparatus to be used therefor."—A communication from S. Dod, Havanna, Cuba.—Petition recorded November 28, 1872.

3678. W. R. Lake, Southampton Buildings, London, "Improvements in the manufacture of malleable cast-iron and cast-steel, and in furnaces therefor."—A communication from J. M. Roberts, Burlington, New Jersey, U.S.A.

3680. T. Petitjean, Islington, Middlesex, "Improvements in the production of metallic surfaces and articles of various forms by chemical means and the electro-deposition of metals, which surfaces or articles are produced either highly polished, dead or matted, engraved, or otherwise ornamented."—Petitions recorded December 6, 1872.

3821. J. L. F. Target, Portsdown Road, Middlesex, "Improved means or apparatus for receiving human excreta, and for distributing, deodorising, or disinfecting powder over the same."—Petition recorded December 17, 1872.

3851. S. Holker, Lumb, near Bury, Lancashire, "Improvements applicable to the treatment of straw, esparto wood, and similar substances used in the manufacture of paper."—Petition recorded December 18, 1872.

3853. F. B. Houghton, Southwark, Surrey, "Improved method of or process for treating spent hops for the manufacture of paper pulp." —Petition recorded December 19, 1872.

3882. W. W. Fereday, Dover Road, Surrey, "Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly concentrated manure."—Petition recorded December 21, 1872.

3913. L. A. Badin, New Ormond Street, Middlesex, "Improvements in closets and apparatus for collecting and disinfecting fœcal matters and converting the same into manure or human guano."—Petition recorded December 24, 1872.

3949. J. Higgin, Manchester, and J. Stenhouse, Pentonville, Middlesex, "Improvements in treating waste liquors containing arsenical or phosphatic compounds, and in obtaining and applying useful products therefrom.—Petition recorded December 30, 1872.

PATENTS SEALED.

2118. E. C. C. Stanford, Glasgow, N.B., "Improvements in preserving and deodorising sea-weed, and in part applicable for deodorising various animal and vegetable substances."—Dated July 13, 1872.

2137. J. Dale, Manchester, "Improvements in the manufacture of oxalates of soda and potash."

2144. S. S. Bateson, Mayfair, Middlesex, "Improvements in the treatment of hides or skins."—Dated July 17, 1872.

2205. H. A. Dufrene, Rue de la Fidelité, Paris, "Improvements in concentrating and evaporating sulphuric acid and other liquids, and in the apparatus employed therefor."—A communication from M. J. F. R. Faure and J. L. Kessler, Clermont-Ferrand, France.—Dated July 24, 1872.

2286. A. Browne, Gracechurch Street, London, "Improvements and modifications in the treatment of phosphate in general, and in the production and purification of phosphoric acid and its combinations."—A communication from H. Storck, E. Hentsch, A. Hentsch, A. Lutscher, and F. Grininger, Paris.—Dated July 30, 1872.

2328. E. Packard, Jun., Ipswich, Suffolk, "Improvements in the manufacture of superphosphate of lime and artificial manure."—Dated August 3, 1872.

2369. W. R. Lake, Southampton Buildings, London, "Improved nutritious compounds,"—A communication from J. R. Weed, New York, U.S.A.—Dated August 9, 1872.

NOTES AND QUERIES.

Coralline and Blackley Red.—How is coralline manufactured, and how used in dyeing? also, how is Blackley red made?—P. Burrows.

MEETINGS FOR THE WEEK.

Monday, Jan. 27th.—Royal Geographical, 8½.
—— Medical, 8.
Tuesday, 28th.—Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
—— Civil Engineers, 8.
Wednesday, 29th.—Society of Arts, 8.
Thursday, 30th.—Royal Institution, 3. Dr. Debus, F.R.S., "On Oxidation."
—— Philosophical Club, 6.
Friday, 31st.—Royal Institution, 9. Mr. Dannreuther, "Music of the Future."
Saturday, Feb. 1st.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

TO CORRESPONDENTS.

⁂ Vol. XXVI. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Dr. B. W. Gerland.—Please forward your address, as there is a letter for you at our office.

A. B. (Widnes).—Yes, but it is little more than a reprint of the Chemical News.

Glasgow Philosophical Society.—Our report of the last meeting of the Chemical Section is unavoidably postponed till next week.

M. H. Cochrane.—Received.

THE CHEMICAL NEWS.

VOL. XXVII. No. 688.

THE INVENTION OF THE WATER-AIR-PUMP.

By H. SPRENGEL.

STATEMENT.*

A LETTER addressed to me by Dr. Sprengel, under date of November 1, 1872, in which he says—"Perhaps it will not have escaped your observation that the invention of the water-air-pump, which you have constructed after the principle of my mercury-air-pump, according to your paper, published in 1868, "On the Washing of Precipitates," is almost everywhere attributed to you"—induces me to make the following statement:—

The interesting discovery that, by means of columns of liquids flowing downwards, a more perfect vacuum can be produced than was possible by the air-pumps hitherto in use, belongs solely and only to Dr. Sprengel. He, in his researches on the vacuum (*Journal of the Chemical Society*, January, 1865), brings prominently forward that water is, from a practical point of view, the only liquid which could come into consideration as a substitute for mercury, used in the instrument described by him, and that it is not unlikely that such an instrument, adapted for water, might possess advantages which air-pumps of other constructions have not, particularly in hilly countries, where the large volume of a natural waterfall might be rendered available. In the theoretical considerations on the action of his instrument, which immediately follow the above, it is noticed that it is simply the reverse of the trompe, with this addition, that the supply of air is limited, while that in the trompe is unlimited.

If, in the face of these facts, which are open to all, anyone attributed to me, as I must conclude from Dr. Sprengel's letter, a share in his discovery, I can regret this only all the more keenly, as in my treatise on the new method of filtration I could not possibly have expressed myself, with regard to Dr. Sprengel's claims, more loyally and precisely than I have done. There I have stated expressly that I have constructed the pump used for filtrations, and described by me in detail, after the principle of Sprengel's mercury-air-pump. It was the only apparatus of the kind which Dr. Sprengel described, consequently the one to which alone I could refer.

(Signed) R. BUNSEN.

Heidelberg, Nov. 5, 1872.

Expressing my best thanks to Professor Bunsen for the above statement, I beg to add that since 1860 I have been using, for laboratory purposes, a water-trompe as described by me in *Poggendorff's Annalen*, vol. cxii., which (by reversing the action) led me, in 1863, to the new method of air rarefaction. Water was the first liquid I used in my first pump, constructed during the summer of 1863; but the fallacies arising from the tension of aqueous vapour, and from the air absorbed in water, as well as the inconvenience of having to provide for the requisite fall, caused me to discontinue the use of water, and to substitute in its stead mercury, as the most suitable liquid for establishing THE truth, which I had recognised by means of a water-air-pump with an insufficient fall. My paper of 1865 was written with reference to ALL liquids; in fact, on page 15 (rendered prominent by italics) I summed up thus:—

"The main fact which I have established in this paper may be shortly stated to be, *that if a liquid be allowed to run down a tube, to the upper part of which a receiver is attached by means of a lateral tube, and if the height at which the receiver is attached be not less than that of the column of the liquid which can be supported by the atmospheric pressure, a vacuum will be formed in the receiver,* minus *the tension of the liquid employed.*"

I regret that the obviousness of the matter led me to refrain from expressing myself in a more detailed manner, believing, as I still believe, that what I wrote sufficiently described the construction of the water-air-pump.

In conclusion, Mr. Johnson's aspirator,* for establishing a current of air, ought to be mentioned here. It was recognised by Professor Hofmann† to act on the principle of the trompe, and, of course, might have served as an air-pump had it been noticed at the time that the instrument would furnish the means of creating a vacuum. And I may also draw attention to the tube‡ of a vacuum-pan, through which the water is made to escape, which has served to condense the steam of the boiling liquid. This no doubt would in like manner have served as a complete water-air-pump, but it does not appear that its use, as such, was discovered.

London, Jan. 22, 1873.

* Translated from *Ann. Chem. Pharm.*, vol. clxv., p. 159, by H. Sprengel, authorised by Professor Bunsen.

CONTRIBUTIONS TO THE HISTORY OF THE ORCINS.—AMIDO-DERIVATIVES OF ORCIN.‖

By JOHN STENHOUSE, LL.D., F.R.S, &c.

IN a paper published in March, 1871,§ I stated that I had made some experiments on the action of reducing agents on trinitro-orcinic acid and trinitro-resorcinic acid; but as Dr. Schreder¶ has since published an account of some of the amido-derivatives of the latter substance, I have not pursued my investigations further in that direction, but confined myself to an examination of the products obtained from trinitro-orcinic acid.

Amido-diimido-orcin, $C_7H_5(NH_2(NH)_2O_2$.—This compound, which has the properties of a base, is formed by the oxidation of triamido-orcin, and is most conveniently obtained in a pure state by decomposing a solution of the acetate with a slight excess of ammonia.

The most advantageous method of preparing the base is to reduce trinitro-orcin with sodium-amalgam, and to oxidise the alkaline solution of triamido-orcin by exposure to the air. The details of the process are as follows:—One part of trinitro-orcin and forty or fifty parts of water are placed in a bottle furnished with a caoutchouc cork, and fragments of sodium-amalgam containing about 3 per cent of sodium are gradually introduced and agitated with the solution, which first acquires a brown colour from the formation of an intermediate amido-product, probably analogous to picramic acid, but becomes colourless as soon as the trinitro-orcin is completely reduced. The solution should be cooled from time to time, as considerable heat is generated during the reaction. When the solution containing triamido-orcin and sodic hydrate has become cold, it is poured into a large flask and agitated briskly; by this means the triamido-orcin is oxidised to amido-diimido-orcin, and the solution assumes a magnificent blue colour.

$$C_7H_5(NH_2)_3O_2+O=C_7H_5(NH_2)(NH)_2O_2+OH_2.$$

A few seconds' agitation is sufficient, as if it be continued after the blue colour is fully developed, the amido-diimido-orcin in the strongly alkaline solution undergoes further oxidation, and is destroyed. On strongly acidulating the blue solution with sulphuric or hydrochloric acid, the corresponding salt of amido-diimido-orcin is precipitated.

* *Quarterly Journal of the Chemical Society*, vol. iv., p. 186, 1852.

† *Ibid.*

‡ "Elements of Physics," by Neil Arnott, M.D. (3rd edition). London: Longmans. 1828.

‖ A paper read before the Royal Society. A preliminary note on this subject appeared in the CHEMICAL NEWS, vol. xxiii., p. 292, and *Zeits. Chem.*, vol. vii., p. 414.

§ *Proc. Roy. Soc.*, vol. xix., p. 410.

¶ *Ann. Chem. Pharm.*, vol. clviii., p. 244.

Instead of directly agitating the colourless solution with air, it may be first neutralised or rendered very slightly acid with hydrochloric acid, cooled, and then rendered alkaline with ammonia. If this solution be now agitated, in the manner before described, it becomes filled with minute green needles of amido-diimido-orcin. Although the first method gives the best results, when carefully conducted, it requires considerable experience to stop the oxidation at the precise point when the whole of the triamido-orcin is oxidised to amido-diimido-orcin, and before the latter becomes destroyed. With the ammoniacal solution there is far less danger of over-oxidation.

Trinitro-orcin is also reduced by treatment with tin and hydrochloric acid, or zinc and hydrochloric or sulphuric acid. One part of trinitro-orcin and four parts of granulated tin are heated in a capacious flask with eight measures of concentrated hydochloric acid diluted with sixteen measures of water. In a short time a powerful reaction takes place, so that it is advisable to remove the flask from the source of heat in order to prevent the contents from boiling over. When the action has become somewhat moderate, the solution is boiled until it is colourless, then diluted with water, and the tin precipitated by hydrosulphuric acid. The clear solution acquires a purple tint on standing, and deposits large dark-coloured prisms of amido-diimido-orcin hydrochlorate, or the amido-diimido-orcin may be obtained directly by adding a slight excess of ammonia to the filtrate from the tin sulphide and oxidising by agitation in the presence of air, when the base immediately separates in minute green needles. Trinitro-orcin and granulated zinc are boiled in a flask with twenty or thirty parts of water, and hydrochloric acid added in small quantities at a time until the solution becomes almost colourless. The clear liquid, poured from the excess of zinc and allowed to cool, is rendered slightly alkaline by ammonia and exposed to the air. As soon as the triamido-orcin is oxidised, which may be known by the brown colour of the product, an excess of hydrochloric acid is added to dissolve the zinc oxide and precipitate the amido-diimido-orcin as hydrochloride. The yield is, however, considerably less than when sodium-amalgam is employed as the reducing agent.

The amido-diimido-orcin sulphate or hydrochlorate obtained by any of the above processes is readily decomposed by treatment with a slight excess of dilute ammonia, leaving the free base in an impure state. This should then be dissolved in warm dilute acetic acid, filtered, and precipitated by a slight excess of ammonia. Two or three solutions and re-precipitations are sufficient to render it pure.

Pure amido-diimido-orcin crystallises in small needles, which have a dark green metallic lustre by reflected light. They are insoluble in alcohol, ether, and benzol, and almost insoluble in water and dilute ammonia. Strong ammonia only dissolves the base in small quantity, yielding a pale blue solution, but it is readily soluble in a solution of sodic hydrate, with a fine deep blue colour; the solution, however, when boiled, loses its colour, ammonia being at the same time evolved. The base gives off ammonia when heated, and leaves a carbonaceous residue very difficult of combustion. As might be expected, when amido-diimido-orcin is treated with sodium-amalgam, it is re-converted into triamido-orcin.

Analysis of Amido-diimido-orcin.—0·290 grm. substance, dried *in vacuo*, lost 0·025 grm. when dried at 100°, equivalent to 8·62 per cent.

I. 0·140 grm. substance, dried at 100°, gave 0·234 grm. carbonic anhydride and 0·075 grm. water.

II. 0·290 grm. substance, dried at 100°, gave 0·487 grm. carbonic anhydride and 0·152 grm. water.

		Theory.	I.	II.	Mean.
C_7	= 84	= 45·40	45·59	45·77	45·68
H_{11}	= 11	= 5·95	5·95	5·81	5·88
N_3	= 42	= 22·70	—	—	—
O_3	= 48	= 25·95	—	—	—
	185	100·00			

It will be seen that the results of the analyses agree with the formula $C_7(CH_3)(NH_2)(NH)_2(HO)_2+H_2O$ for the substance dried at 100°, and the formula for the substance dried *in vacuo* is probably—

$$C_6(CH_3)(NH_2(NH)_2(HO)_2+2H_2O,$$

as it requires 8·87 per cent water.

Triamido-orcin.—The colourless solution obtained by the reduction of trinitro-orcin with tin and hydrochloric acid, after removal of the tin by sulphydric acid, appears to contain triamido-orcin hydrochloride along with excess of hydrochloric acid. On concentrating the solution at 100°, much of the triamido-orcin is decomposed and a considerable amount of ammonium chloride formed; whilst, although long needles of triamido-orcin hydrochloride are obtained by evaporating it in a vacuum, yet owing to their great solubility, and the readiness with which they absorb water and deliquesce, the salt has not yet been obtained in a state fit for analysis. On moistening the crystals of this hydrochloride with ammonia they become almost instantaneously converted into the metallic-green needles of the amido-diimido-orcin.

If a current of sulphuretted hydrogen be passed through a solution of ammonium sulphydrate in which amido-diimido-orcin is suspended, the latter rapidly loses its colour, and becomes converted into a sandy deposit consisting of colourless crystals. These are apparently triamido-orcin, and may be washed by decantation with a dilute solution of ammonium sulphydrate, in which they are but slightly soluble. These crystals rapidly acquire the metallic-green lustre of amido-diimido-orcin when exposed to the air, and are readily soluble in dilute acids. The hydrochloric acid solution behaves in a manner precisely similar to that obtained by the reduction of trinitro-orcin with tin and hydrochloric acid, becoming deep red, and depositing crystals of amido-diimido-orcin hydrochloride when exposed to the air.

Amido-diimido-orcin Hydrochloride.—The hydrochloride obtained in the preparation of amido-diimido-orcin, as described in the earlier part of this communication, may be purified by crystallisation from hot water; but as heat decomposes solutions of the salts of this base, it is better to precipitate a cold solution of the acetate by a slight excess of hydrochloric acid, in which the hydrochloride is but slightly soluble: the precipitate should be thoroughly washed with alcohol, pressed, and dried.

Pure amido-diimido-orcin hydrochloride crystallises in different ways, according to the circumstances under which the crystals are formed. As produced directly by adding hydrochloric acid to the blue solution of the base in caustic soda obtained from trinitro-orcin by sodium-amalgam, it forms long silky needles of a brownish-red colour; an aqueous solution of the acetate or hydrochloride precipitated by an excess of hydrochloric acid yields a mixture of these needles with rhomboidal plates; the latter are purple by reflected light, and of an olive-green colour by transmitted light. The slow oxidation of the hydrochloric acid solution of triamido-orcin obtained by means of tin and hydrochloric acid yields dark-coloured, short, thick prisms. The hydrochloride is insoluble in alcohol and ether, moderately soluble in cold water, and readily in boiling water, although the latter causes partial decomposition. Its aqueous solution is precipitated almost entirely on acidulating it with hydrochloric acid; but the salt is soluble in concentrated hydrochloric acid, especially when warm, forming a purple solution. On boiling this the salt is rapidly decomposed, and the colour changes to a dirty green.

Analysis of Amido-diimido-orcin Hydrochloride.—0·428 grm. substance, dried *in vacuo*, lost 0·035 grm. when heated to 100°, corresponding to 8·41 per cent water.

I. 0·255 grm. substance, dried at 100°, gave 0·180 grm. argentic chloride.

II. 0·232 grm. substance, dried at 100°, gave 0·164 grm. argentic chloride.

III. 0·344 grm. substance, dried at 100°, gave 0·242 grm. argentic chloride.

		Theory.	I.	II.	III.	Mean.
$C_7H_{10}N_3O_2$	= 168·0	82·55	—	—	—	—
Cl	= 35·5	17·45	17·47	17·49	17·40	17·45
	203·5	100·00				

These results correspond nearly to the formula—

$$C_6(CH_3)(NH_2)(NH)_2(HO_2)HCl$$

for the substance dried at 100°; and the formula—

$$C_6(CH_3)(NH_2)(NH)_2(HO)_2HCl+H_2O$$

requires 8·13 per cent water, and would therefore appear to be that of the substance dried *in vacuo*.

Amido-diimido-orcin Sulphate.—This salt is readily prepared by precipitating a dilute solution of the acetate with sulphuric acid, when it forms minute lustrous plates, which are purple by reflected light. By slow crystallisation from a hot aqueous solution it may be obtained in large leaf-like plates. It somewhat resembles the hydrochloride in its properties, but is much less soluble in water.

Analysis of Amido-diimido-orcin Sulphate.

I. 0·255 grm. substance, dried at 100°, gave 0·128 grm. barium sulphate.

II. 0·284 grm. substance, dried at 100°, gave 0·143 grm. barium sulphate.

		Theory.	I.	II.	Mean.
$(C_7H_{12}N_3O_3)_2$	= 372	79·49	—	—	—
SO_4	= 96	20·51	20·65	20·72	20·69
	468	100·00			

The formula of this salt would therefore appear to be—

$$[C_6(CH_3)(NH_2)(NH)_2(HO)_2]_2SO_4+H_2O.$$

Amido-diimido-orcin Nitrate is prepared, like the sulphate, by adding a slight excess of nitric acid to a moderately strong solution of the acetate, and washing the precipitate with alcohol. It closely resembles the sulphate in appearance, but is much more soluble in water. When heated with excess of nitric acid it is decomposed, yielding a yellow solution, which, on being evaporated, leaves a mixture of oxalic acid and an amorphous yellow substance.

Amido-diimido-orcin Acetate.—Amido-diimido-orcin dissolves readily in acetic acid, and on carefully evaporating the solution, at a low temperature, the acetate is obtained in ill-defined crystalline plates having a purple iridescence. It is readily soluble in cold water, but only slightly soluble in glacial acetic acid.

Amido-diimido-orcin Oxalate.—Very slightly soluble purple scales obtained by precipitating a solution of the acetate with oxalic acid.

Amido-diimido-orcin Picrate.—On adding a solution of picric acid to a dilute solution of amido-diimido-orcin acetate, and washing the precipitate with alcohol, the picrate is obtained in iridescent green needles and plates. It is insoluble in alcohol, and but slightly soluble in water.

I cannot conclude this paper without acknowledging the very efficient aid I have received from my assistant, Mr. Charles Edward Groves, in conducting this investigation.

ON ULTRAMARINE.*

By C. UNGER.

ALTHOUGH ultramarine has been frequently the subject of research, its chemical nature has not hitherto been well elucidated, and the supposition that it contains sulphuret of aluminium or sulphuret of sodium, or a polythionate of soda, becomes a dubious matter, seeing that ultramarine is not decomposed by fused chlorate of potassa, while it (the ultramarine) resists, for some length of time, fusion with alkalies and nitrates. Ultramarine, when ignited with soda-lime, yields only a trace of ammonia; but, when ignited with phosphor salt, or with an alkaline bisulphate, nitrogen is largely given off. This reminds me of an old observation made by the late Berzelius, who states, in his treatise on the blowpipe, that, when *lapis lazuli* is treated with phosphor salt, the mineral is dissolved with a continuous effervescence yielding a colourless bead. Nothing is said as regards the nature of the gas alluded to; it is probable, however, that even then it may have been known that *lapis lazuli* contains nitrogen. When I analysed a sample of artificially-made ultramarine, free from sulphuret of sodium, as well as from any acid of sulphur, I found that sample to contain—deductions being made for some kaolin which had escaped the process of conversion, and for some soda separated by treating the residue left after my operations with chloride of ammonium—upon 12·6 per cent of sulphur, 5·5 per cent of nitrogen, or equal atoms of each of these elements, and further—

	Per cent.
Sodium	14·1
Aluminium	14·4
Silicium	20·4
Oxygen found by loss	33·0

Nearly, if not quite, all the oxygen contained in this ultramarine is evidently combined with sodium, aluminium, and silicium, forming soda, alumina, and silica, which are colourless compounds. On the other hand, the elements which form the blue-coloured compound ought to be present in atomistical proportions; and upon 1 atom of sulphur or nitrogen there must be at least 1 atom of sodium or aluminium, silicium or oxygen, supposing there is an excess of these. Now it is well known that ultramarine gelatinises when treated with acids, thereby proving that the silica is really combined with bases. The blue-coloured body must contain, for 1 atom of nitrogen, 1 double atom of aluminium and 1 atom of silicium, but no sodium, otherwise there would not be left a sufficient quantity of basis for the silica of the colourless body, without which (soda) the gelatinising by the action of acids cannot take place. The supposition of the presence of only 1 double atom of aluminium in the blue-coloured body is based upon the fact that the quantity of aluminium found by analysis is not sufficiently large to admit of the presence of 2 double atoms of that element; while, as regards silicium, there can only be 1 atom, since the second atom must of necessity be combined with oxygen, which would otherwise be present in free state, and in order to find elements to combine with the oxygen present, it is evident that it (the O) is to be divided between the sodium, aluminium, and silicium; there remains then, however, a residual quantity of oxygen, which must belong to the blue body, since it is ascertained that that O is not a constituent of an acid of the sulphur or of the nitrogen. Consequently the analysed sample of ultramarine contained 55·7 per cent of silicates of soda and alumina, with a relation of the oxygen in the acids and bases = 2 : 1 and 44·3 per cent of the blue body, $AlSiS_2N_2O_3$; this formula is based upon the following data:—

I first investigated which of the salts present in the well-known mixture employed in the making of ultramarine during the calcination process form, with kaolin, ultramarine blue. I found that neither sulphur, sulphite of soda, hyposulphite of soda, nor mono- or poly-sulphuret of sodium have this effect; but I ascertained that hyposulphite of soda does so when mixed with either carbonate or caustic soda. 1 equivalent of carbonate and 2 equivalents of hyposulphite of soda react upon each other, but the deepest blue is formed when equal equivalents of silica and alumina are applied. The result I obtained by a large number of calcinations with differently made up mixtures proved that the blue body is most copiously formed when the mass to be calcined is compounded according to the following formula:—

$$AlO_3+SiO_2+4Na_2S_2O_3+2Na_2O \text{ or } 2Na_2CO_3.$$

* A criticism of this Article appeared in our last number.

Since, however, the two soda salts are, while being ignited, decomposed in such a manner that half of the sulphur forms sulphate of soda; and since this decomposition begins early in the calcination process, while silicates of soda and alumina are also formed, it is only a relatively small portion of the soda salts which, with the earths, forms blue ultramarine.

The following reasoning convinced me that the formula quoted above for blue ultramarine is correct. Artificially-made ultramarine contains a silicate and a residue $=AlO_3SiS_2N_2O_3$; while, among all the bodies containing sulphur, there is only one which yields, with the aid of carbonate of soda, blue ultramarine, and this of the finest quality and largest quantity, when the mass to be calcined consists of—

$$AlO_3+SiO_2+4Na_2S_2O_3+2Na_2O \text{ or } 2Na_2CO_3.$$

I find that there is then formed $4Na_2SO_4$.* (Some accessory reactions, such as the formation of polysulphuret of sodium, of silicate, &c., do not alter our view, because by these reactions the quantity, not the quality, of the ultramarine-blue is altered.) Since, then, $4Na_2SO_4$ are formed, the residue is $=AlSiNa_4S_4O_3$, which differs from the residue in the finished blue-ultramarine by a *plus* of $2Na_2S$ and a *minus* of N_2. After the washing with water in the presence of air, the calcined mass is first analysed (the analysis of the ignited mass immediately after its removal from the furnace is impracticable, on account of the necessity of working in a vacuum with exclusion of all air), and found to consist of a silicate and of a residue $=AlSiS_2O_5$, formed by the elimination of $2Na_2S$ and absorption of $2O$.

When this washed and dried mass, which is somewhat bluish-green colour, is ignited with chloride of ammonium, the result is the formation of corn-flower (*Carduus benedictus*), blue-coloured ultramarine. The hydrogen of the chloride of ammonium partly forms water and is partly eliminated as gas; the chlorine is found combined with sodium; while the nitrogen combines with the blue-coloured body.

When this calcined, washed, and dried mass is ignited in contact with vapour of sulphur, the original faint bluish-green colour of the calcined mass is retained until it is ignited in contact with air. Again, if the once calcined mass is fused with chlorate of potassa, previous to being ignited with sulphur, the mass retains, after ignition with the last-named substance, its original colour, and only turns blue (becomes ultramarine) when ignited in contact with air. Consequently, in each case a deoxidation precedes the addition of nitrogen.

On comparing the composition of the hardly-coloured body with that of the ultramarine formed from it, or when it is tried to determine the change of weight which the first-named body undergoes by its conversion into the second, the quantity of the fire-proof (*feuerfesten*) materials and the sulphur contained in both is found to be the same. As, therefore, a difference of weight cannot be ascertained with certainty (at least, not at all in preparations which contain about 15 per cent of the blue compound), there only remains the supposition that the oxygen eliminated by reduction weighs nearly as much as the nitrogen taken up, or that an equal number of atoms of the oxygen are exchanged for an equal number of atoms of nitrogen. Although the nitrogen has not been estimated in the sample of ultramarine which I prepared on the small scale, I have no doubt that the blue-coloured body owes its colour as much to nitrogen, as is the case with the ultramarine made on the large scale, a sample of which was analysed by me.

The following formulæ exhibit, beginning with that of the mixture of the dry materials to be made, by calcination, into ultramarine, the various reactions of the process:—

$$\underbrace{AlO_3+SiO_2+4Na_2S_2O_3+2Na_2CO_3}_{\text{Dry mixture to be calcined.}}=$$

$$=\underbrace{AlSO_2+SiSO+2Na_2S+4Na_2SO_4+2CO_2}_{\text{Sulphobasic oxysulphuret, which is removed.}}.$$

Addition to it of 2O from the air=

$$\underbrace{AlSiS_2O_5}_{\text{Ultramarinogen.}} \quad + \quad \underbrace{2Na_2S}_{\text{Which is removed.}}.$$

Addition to it of S as vapour—

$$\underbrace{AlSiS_2O_3}_{\text{Oxysulphuret.}} \quad + \quad \underbrace{SO_2}_{\text{Which is removed.}}.$$

Addition to it of 2N from the air—

$$\underbrace{AlSiS_2O_3N_2}_{\text{Ultramarine.}}.$$

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* Found in three calcined mixtures, 49·5, 53·4, 46·7 per cent of sulphur, due to the total quantity of hyposulphites, on an average 49·8 per cent.

ON THE ACTION OF PHOSPHORUS UPON ALKALINE METALLIC SOLUTIONS.

By A. OPPENHEIM.

It is my intention briefly to record here what was *viva voce* communicated to the Society in the earlier part of this year (1872), respecting the researches made by me for the purpose of preparing phosphorus metals (phosphurets) by a new method. There can be no doubt that it is of great importance to obtain such a method, not only because it will enable us thus to prepare new organic phosphines, but, also, because we shall become better acquainted with the metallic phosphines (phosphurets). In the older systems of, and works on, chemistry, the phosphurets are classified with the oxides and sulphurets, as may be seen in Lavoisier's "Traité de Chimie," and in Berzelius's exhaustive work on chemistry. Up to the present day very few metallic phosphines exhibiting a well-defined character and agreeing with our present views of valence (*valenz*) have been obtained. Only rarely and with rather dubious results has the reduction of phosphates been tried for the preparation of the phosphurets, most of which have been prepared, either by the melting together of the elements, or by heating the metals in the vapour of phosphorus. Dr. Schrötter applied the last-named method, and thus obtained a series of incomplete (*unvolkommen*) or non-crystalline compounds, but it was difficult to say whether they really were chemical combinations. Hooslef employed the same method, and also the plan of reducing, by means of charcoal, the oxides of the metals previously mixed with phosphoric acid. He obtained some partly crystalline bodies, the composition of which curiously jars, with one exception, with our views on the trivalence of phosphorus; the formulæ are the following:—

$$Fe''P,\ Fe_3''P,\ Cu_2''P,\ Cu_3''P,\ Zn''P_2, \text{ and } Zn_3''P_2$$

(the only one agreeing with the trivalence of phosphorus). It is clear that by the use of the methods just alluded to there is a danger of mixtures of several different combinations, or so-called alloys, being obtained.

The most ready way to obtain phosphurets—the precipitation of metallic solutions by phosphuretted hydrogen—is of no use, because the precipitation either fails altogether, or is incomplete. It is true that the salts of the noble metals are precipitated, but, as proved by H. Rose, not as phosphurets, but as reduced metals in finely divided state. It might be suggested that, instead of using the hydrogen of the phosphuretted hydrogen as a reducing agent, the phosphorus itself might be so applied; that is to say, whether it would not be possible to obtain phosphurets by heating metallic

solutions with phosphorus. Of course there is a risk, to be avoided as much as possible, of getting with the phosphurets other compounds, such as, for instance, insoluble phosphates, or phosphites and hypophosphites. On this account I operated with metals in alkaline solution, so that any of the phosphorus acids which might happen to be formed should combine with the alkali and not with the metal. I have thus operated with oxide of copper dissolved in ammonia, protoxide of nickel dissolved in ammonia, oxide of lead in potassa, oxide of silver in ammonia, oxide of cadmium in potassa, protoxide of tin in potassa, and oxide of zinc in ammonia. Excepting the two last named, which, even when strongly heated with the phosphorus in sealed tubes, were not acted upon at all, the solutions were heated with phosphorus in excess, and benzol for the purpose of dissolving the phosphorus. The vapours were re-conducted to the flask, in which the operation took place, by means of a condenser vertically connected therewith; while, by frequent agitation, the contact between the phosphorus and metallic solutions was promoted. I, moreover, took care to occasionally add more ammonia to the solutions containing that liquid.

The tin solution yielded only a white-coloured slimy mass, similar to that which the acids of the phosphorus yield with the oxides of tin, and therefore I did not further investigate these substances.

The solutions of copper, nickel, lead, silver, and cadmium yielded dark-coloured precipitates, which were first washed with water and alcohol, and next with sulphide of carbon, for the purpose of eliminating any excess of phosphorus, after which the substances were dried *in vacuo*.

The deep brown-coloured precipitate obtained from the copper solution was found to be mixed with specks of metallic copper, and yielded by analysis only a small quantity of phosphorus; the bulk of the mass was metallic copper and protoxide of copper. The nickel solution gave a black-coloured precipitate, the composition of which was found to vary in the different samples I prepared. I found for instance—

	1.	2.
P	12·20	12·8
Ni	67·07	66·8

This substance was evidently a mixture of phosphuret of nickel, and the salt of a phosphorus acid akin to that which Dr. Rammelsberg lately obtained while igniting hypophosphite of nickel (See *Ber. d. Deutsch. Chem. Gesells.*, vol. v., p. 495, 1872). The lead solution also yielded a black-coloured precipitate, which was found to contain from 98 to 99 per cent of metallic lead, and about from 0·4 to 0 per cent phosphorus not chemically combined, but only mechanically mixed with the lead, which on being heated in a current of hydrogen did not, while melting, yield any phosphuretted hydrogen. The silver, also, had been precipitated, yielding finely divided grey-coloured metallic silver, which, on being heated in a current of hydrogen, became white coloured (frosty), similar in every respect to the silver obtained by Rose while treating a solution of that metal with phosphuretted hydrogen. I found the samples prepared by me to contain on analysis from 97·39 to 99 per cent of silver. The cadmium solution yielded a light brown-coloured pulverulent precipitate, which, after having been purified as above described, evolved when treated with hydrochloric acid a large quantity of phosphuretted hydrogen; while when treated with nitric acid it exploded with simultaneous combustion, bursting into flame of the gas which was liberated. I had, therefore, in this instance to deal with a phosphuret of cadmium, but not pure, since the results of the analysis varied greatly in different samples: for instance—

P	17·7	15·03
Cd	76·4	67·00

On being heated in a current of hydrogen this substance yields water (due to an oxygen-containing substance mixed up with the material as an impurity); further, vapour of phosphorus and phosphuretted hydrogen, while there is left a grey-coloured metallic crystalline body, the composition of which corresponds to the formula Cd_3P_2.

	Calculated.	Found.
Cd	84·43	83·98
P	15·57	15·70

The phosphor-cadmium was found not to answer for the purpose of double decomposition in organic substances (iodide of ethyl, sulphide of ethyl). Herr E. Schatz has greatly assisted me in these researches.—*Ber. d. Deutsch. Chem. Gesells.*

ON THE

ESTIMATION OF SULPHUR IN COAL AND ORGANIC COMPOUNDS.

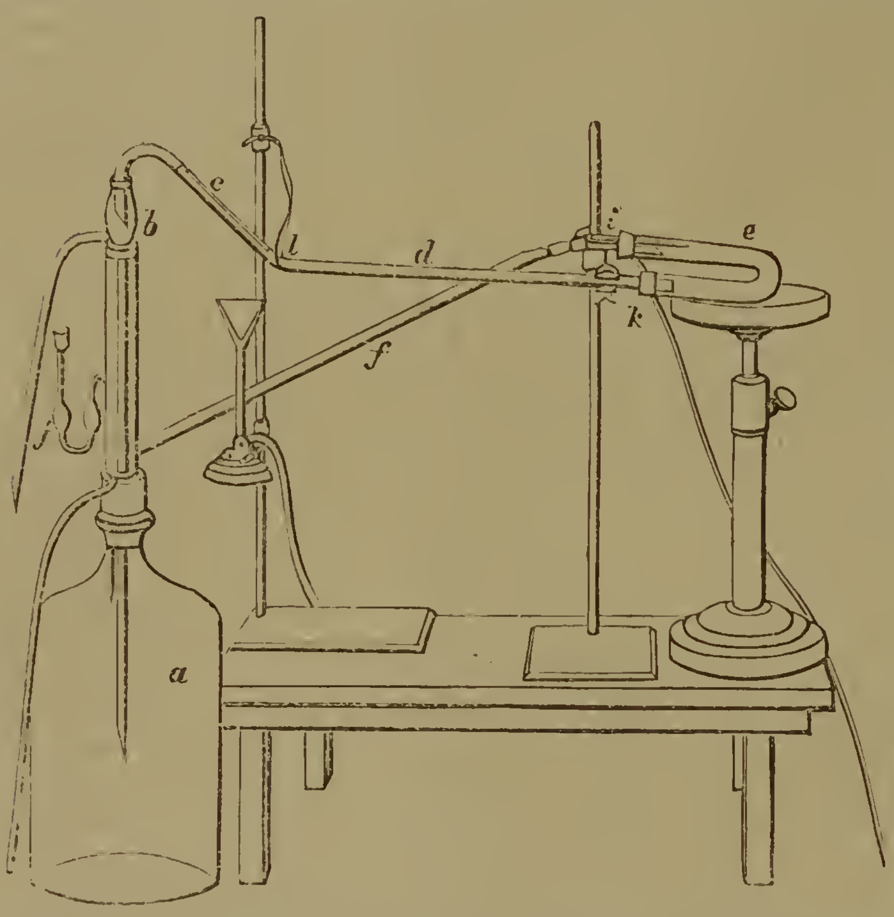
By W. G. MIXTER.

The determination of sulphur in organic substances by many of the methods in use is not only a difficult and tedious operation, but the amount of fixed reagents often employed greatly increases the liability to error. In the process here described, substances are burned in oxygen, and the sulphur is condensed from the gaseous products in the form of sulphuric acid.

Experiments made by passing the products of combustion of sulphur compounds through nitric acid failed to give satisfactory results. A variable loss was due to a dense white fume containing sulphuric acid, which was not completely absorbed by water or by caustic alkalies. The apparatus here described was designed for making the combustions in a confined volume of gas, to avoid this source of error. The bottle, *a* (see figure), has a capacity of from 4 to 10 litres, according to the amount of oxygen required. The neck should be large enough for a stopper 35 to 40 m.m. in diameter. The condenser, *b*, is made of rather thin tubing, 14 m.m. in diameter; at the upper end it is expanded to a bulb, in order to admit some motion to the tube *cd*. Below the bulb it is surrounded by a water-jacket 22 c.m. high; from the point where it enters the stopper of the bottle it is narrowed somewhat for convenience of fitting. The combustion-tube *cd* is made of hard glass of 12 to 15 m.m. internal diameter; the portion *c* is 18 c.m. from curve to curve, and is protected by a sheet-iron trough lined with asbestos; the part *d* is from 35 to 45 c.m. in length. The wire attached at *l* is to sustain *c* in case *d* breaks; *c* is joined to *b* by a collar of black rubber. The U-tube *e* is connected with *d* by a rubber collar drawn over the latter at *k*; this U-tube is slightly inclined, that no liquid may run against the rubber connectors. The tube *f* connects *a* with *e*; it is narrowed at both ends to 10 m.m. diameter. Near the upper end it is jointed by a piece of black rubber tubing in order that the apparatus may be easily disconnected at *k*. The ends of *f* extend 2 c.m. or more beyond the stoppers. Through the rubber stopper, *i*, a small glass tube passes beyond the end of *f*, where it is narrowed to an opening of 1 m.m. The double-bulb tube, *j*, is to accomodate variations of pressure, and to admit air as the original volume of gas diminishes during the combustion. The tubes *b*, *c*, *d*, and *f* should at no point have an internal diameter less than 8 m.m.—10 m.m. is preferable—and the narrowed ends should be cut obliquely that drops of water may not obstruct the circulation. The rubber stoppers and connections should be freed from adhering sulphur by heating in a solution of sodium hydrate. The joints of the apparatus are sufficiently tight when water will stand in one limb of the safety-tube.

The bottle, *a*, is filled over water with oxygen, and, if necessary, rinsed with distilled water a few drops of

bromine are poured in, the tubes adjusted, and a slow stream of water made to flow through the water-jacket. The assay, if not volatile, is introduced into the tube *d* in a platinum tray,* which should not fill more than half the bore of *d*, leaving space enough for the free circulation of the oxygen. The part *c* is gradually heated, and kept hot during the combustion. This hot inclined tube acts as a chimney; the heated gases rise in it, pass into the cold tube *b*, and fall, thus causing a constant stream of gas to pass over the assay. It is important to ignite the assay without distilling off any considerable portion. To do this a small splinter of wood may be placed in contact with that part of the substance nearest *l*, or that end of the tray may hold a thin layer of the assay, which is heated as rapidly as safety allows by a lamp held in the hand. To ensure a full supply of gas in the tube *d* at the commencement of the combustion, oxygen is passed from a gasometer through the tube *i* till the white fume which appears in the condenser, *b*, passes into *a*. The products of combustion, being denser, fall to the bottom of the bottle, and for a while displace the oxygen, thus increasing the circulation. After the substance is ignited, the fire passes to the other end of the tray. The part of the tube about the tray is heated by a lamp which is required to keep



up the combustion. At the end of the operation the heat is increased. If drops of liquid collect in *c*, and are liable to run down to the hotter parts of the tube, they should be driven off by heat. If carbonic acid be the principal product of the combustion, there is little change in the volume of gases in the apparatus; but if water and sulphuric acid are formed in much quantity, the volume is diminished, and air enters through the safety-tube.

Most solid substances heated alone in the open tray yield volatile products too rapidly for entire combustion, but if mixed with sand in suitable proportion they burn slowly and completely. Liquids should be enclosed in narrow tubes sealed at one end and drawn out at the other to a capillary bore for 2 or 3 inches of length. Upon the point of the tube a bit of platinum sponge is fixed to assist the oxidation. The liquid should not fill more than two-thirds of the wider part of the tube.

Before introducing very volatile substances, the 10 c.m. of the combustion-tube *ld* should be heated to dull redness. Oxygen is passed in at *i*, the tubes are disjointed at *k*, and the tube holding the assay is then pushed in till the platinum just reaches the heated zone. The apparatus being connected at *k*, slow volatilisation of the liquid is effected by cautiously applying a flame under the empty portion of the tube containing the substance, so as to maintain the platinum-sponge in a steady glow. As soon as a cloud of combustion-products appears in the vessel, *a*, oxygen is shut off from *i*. When all the liquid has distilled from the interior tube, the tube *cd* is cooled slowly, and the apparatus is left for two hours, or until the fume has entirely subsided. If no odour of bromine be perceptible when the apparatus is disconnected at *k* to remove the tray or tube, a few drops of it should be poured through a funnel-tube put in the place of *j*, and the whole allowed to stand some time, to ensure complete oxidation of the sulphur compounds and deposition of the sulphuric acid.

The tubes *d* and *c* are then rinsed into a beaker; this water is poured into *b*, which is then thoroughly washed by the aid of the wash-bottle. The large rubber stopper is lifted from the bottle, and the lower part of *b* rinsed; without removing the tube *f* from the stopper, it is rinsed into a beaker, and, finally, the bottle is carefully washed. The solution obtained, which need not exceed 500 c.c., is evaporated to a small volume, filtered, if necessary, and the sulphuric acid precipitated by barium chloride. The barium sulphate washes easily, as the solution contains no nitrates or fixed salts; its purity is ascertained by treatment with water and a few drops of chlorhydric acid, warming some time, filtering, and re-weighing. In case the substance leaves an ash or residue in the tray, this must be dissolved in aqua regia, the nitric acid removed by evaporation with strong chlorhydric acid, and any sulphuric acid it may contain separated in the usual manner. In the use of this apparatus there is no danger from explosions, if care be taken to have the combustion-tube hot enough to ignite combustible vapour. Before attempting to burn a substance in the apparatus, it is best to try it in a large inclined tube open at both ends, or with oxygen supplied at the lower end. Such a preliminary trial will usually indicate the precautions necessary in burning the substance in the apparatus.

The writer found that when oxygen prepared from a mixture of potassium chlorate and manganese dioxide, or from the chlorate alone (no rubber stoppers or connections being employed), stood some time in a bottle containing a few drops of bromine and a little water, the water gave a slight turbidity with barium chloride. Neither the bromine nor the solution of the chlorate gave reactions for sulphuric acid; the manganese dioxide contained, however, a trace of sulphur. Combustions of alcohol and of sugar-charcoal, made by the method here described, yielded with barium chloride a precipitate apparently no greater than that obtained from the oxygen alone, and too slight to influence ordinary results. This shows that, with suitable care, rubber stoppers are not objectionable.

The following results, obtained in the order they are given, show the applicability of the method, while some of the details mentioned may help to explain the use of the apparatus:—

	Weight Taken.	Per cent Found.
1. Iron pyrites (mixed with carbon) ..	0·0658	51·20
2. ,, ,, ...	0·0597	51·26
3. Sulphur	0·2070	99·76
4. ,, ...	0·2807	99·92
5. ,, ...	0·4951	99·93
6. ,, ...	0·5882	100·02
7. Carbon disulphide	0 7725	84·12
8. ,, ,, ...	0·4598	84·16
9. Bituminous coal	0·6640	2·97
10. ,, ,, ...	0·7860	2·99
11. Wool	0·4640	3·44
12. ,, ...	0·4675	3·46
13. Tobacco	2·0720	0·37
14. ,, ...	2·1370	0·36

9 litres of oxygen were used in Nos. 1, 2, 13, and 14 and 4 litres in each of the other analyses.

* A platinum tray which answers well may be made 10 to 20 c.m. long, 10 m.m. wide, and 7 to 10 m.m. deep, by bending thin foil over a glass tube. The ends may be roughly bent together or left open.

In No. 1 the iron pyrites was mixed with 1·3 grs., and in No. 2 with 2 grs. of sugar-charcoal, and the residues remaining after the first combustion were mingled with a small additional portion of charcoal, and the combustion repeated to remove the last traces of sulphur. The solutions of the final residues in aqua regia, after evaporation nearly to dryness to expel the excess of acid, gave no turbidity with barium chloride. The sulphur in this pyrites was estimated by another method by way of control.* This mixture o fpyrites with charcoal was used as an imitation of coal, which should contain a known amount of sulphur.

The sulphur used in Nos. 3, 4, 5, and 6 was purified by crystallisation from carbon disulphide solution, and fused. It was placed in a narrow weighed glass tube from 5 to 7 c.m. long, boiled, allowed to cool, and the whole weighed. During the combustion of No. 4, the sulphur volatilised so rapidly at one time that a portion escaped unburned, and formed a coating in the neck of the combustion-tube and in the condenser, which soon disappeared, probably oxidised by the action of sulphuric acid and bromine.

The carbon disulphide was the commercial article, purified by distillation from calcium chloride and quicklime. The boiling-point was constant. The per cent of sulphur calculated is 84·21. On account of its volatility and resistance to the action of bromine, it required more care in its combustion than pure sulphur. It was weighed in a sealed tube having a neck 3 inches long with a very fine bore. The end of this neck was broken off, and the open point was thrust into a cylinder of platinum-sponge wrapped in foil, and the whole was quickly placed in the combustion-tube as has been described.

The powdered bituminous coal was burned in a tray. In No. 10 some tarry matter passed into the condenser. No sulphur was found in the reddish ash, which amounted to 5·57 and 5·22 per cents.

The wool was from South Down sheep. It was purified by washing with soap, and afterward with ether, and was dried at 212°. Wool swells so by heat that it cannot conveniently be burned in an open tray. No. 11 was contained in a glass tube sealed at one end. After the volatile matters had been burned off, the tube was taken from the apparatus, the closed end was broken, and the charred residue mostly transferred to a tray, which, together with the tube, was returned to the combustion-tube to complete the oxidation. In No. 12 a small platinum tube, extemporised from foil, closed at one end by a glass plug, was employed.

The pulverised tobacco of No. 13 was burned in an open tray, and the combustion occupied less than five minutes. A small amount of hydrocarbons passed over unconsumed, and, owing to the intense heat, a white sublimate formed above and beyond the tray. No. 14 (same tobacco) was mixed and covered with sand; the combustion lasted twenty minutes, and the oxidation was complete. The ash of the tobacco retained by far the larger part of the sulphur. In No. 13, 0·11, and in No. 14 0·03, per cent of sulphur was obtained from the gaseous products. Mr. E. S. Breidenbaugh found in the same sample, by Reichhardt's method,* 0·36 per cent.

It is plain that the sulphuric acid of the gaseous products is obtained by this process under conditions highly favourable for its exact estimation. The solution from which it is precipitated contains no fixed salts and no nitric acid, the presence of which renders the barium sulphate difficult to purify, but only sulphuric and bromhydric acids. The only impurities that can attach to the barium sulphate are accordingly barium chloride and bromide. The former may be perfectly removed by warming the ignited precipitate with dilute chlorhydric acid, as Fresenius has conclusively shown in a late paper.† This method of purifying the barium sulphate has also the sanction of Bunsen.‡ It is not probable that barium bromide would resist treatment which removes the chloride. In the analyses given, the writer added barium chloride slowly to the concentrated boiling solution, and after twelve hours or more decanted the supernatant liquid, boiled the precipitate with two or more portions of water, and washed with hot water till sulphuric acid gave no turbidity in the washings. The precipitate washed rapidly, and an hour to an hour and a half generally sufficed for the largest ones. In purifying the larger precipitates, they were placed in a beaker with from 50 to 100 c.c. of water and a few drops of acid. Any lumps were broken up by a rod, and the whole was boiled half an hour or more. The smaller precipitates were treated in the crucibles. In all cases the purifying was continued till sulphuric acid gave no reaction for barium salts in the last filtrate. The precipitates, weighing from 2 to 4 grs., lost, by digesting with dilute chlorhydric acid, from 0·007 to 0·020 gr.

To Professors Johnson and Allen I desire to return thanks for their assistance and for many valuable suggestions.—*Am. Journ. Sci.*

* The analyses of pyrites were mostly made by a modification of the method of Storer and Pearson (*Am. Journ. Sci.*, xlviii., 190). The pulverised iron pyrites (0·2 to 0·5 grm.) was mixed with thrice its bulk of powdered potassium chlorate; about 25 c.c. nitric acid, sp. gr. 1·40, were then added to the mixed powders, and the whole was heated cautiously, but not to boiling, for fear of melting the sulphur which separated. A complete solution was obtained in five to ten minutes; it was evaporated to dryness, and the evaporation twice repeated with the addition of chlorhydric acid. The barium sulphate was finally precipitated from the solution containing but a few drops of free acid. It was washed first by decantation with water, was then digested with three separate portions of ammonium acetate, and the washing was continued with water till sulphuric acid gave no turbidity in the washings. These precipitates, after ignition, yielded no barium salts to hot dilute chlorhydric acid; they were slightly reddish in colour, and the sulphur calculated from their weight amounted to 51·69 and 51·73 per cent respectively. In two other determinations, potassium-sodium tartrate (no pure tartaric acid being at hand) and chlorhydric acid were added to the solutions before precipitating, with the hope of retaining the iron in solution more perfectly; the barium sulphate was treated as above described. The precipitates had, notwithstanding, a reddish colour, and corresponded to 51·78 and 51·63 per cent of sulphur respectively. They yielded nothing to dilute chlorhydric acid, and were accordingly free from adhering barium salts. They were, according to the suggestion of Mitscherlich (*Journ. f. Prakt. Chem.*, 83, 456), dissolved in strong sulphuric acid, thrown down by water, washed, and again weighed. They were now free from iron, and corresponded to 51·28 and 51·40 per cent of sulphur respectively. In another estimation, the barium sulphate, which contained a large amount of ferric oxide, was slightly washed with water, then fused with sodium carbonate, extracted with water, and the sulphuric acid thrown down from the aqueous solution after addition of a slight excess of chlorhydric acid. The barium sulphate, thus obtained free from iron, was digested with ammonium acetate, and finally washed with water. The sulphur calculated from it was 51·27 per cent. The latter plan of purifying barium sulphate has long been employed by Prof. O. D. Allen in the analysis of iron ores, and its publication was made nearly simultaneously in the American edition of Fresenius's "Quantitative Analysis," p. 525, from notes furnished by Prof. Allen, and in a paper by Fresenius in his *Zeitschrift*, x., 52.

* Caldwell's "Agricultural Qualitative and Quantitative Analysis," p. 246.

† *Zeit. f. Anal. Chem.*, Bd. ix., s. 52.

‡ *Ibid.*, Bd. x., s. 396.

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY. (CHEMICAL SECTION).

Ordinary Meeting, January 13th, 1872.

DR. WALLACE, F.R.S.E., President, in the Chair.

"*On the Composition of some Zeolites*," by J. WALLACE YOUNG.

The term zeolite is applied to a class of minerals consisting essentially of silica, alumina, water, and some alkali or alkaline earth. As they occur more or less abundantly in all the older trappean rocks, they have been, perhaps, better examined than many other minerals, and it might therefore appear a little out of place on my part going over such well-trodden ground. The principal object

I had in view, however, was the correct determination of the alkalies present, which, by the older methods, was tedious and often unsatisfactory, but which the excellent process of Professor Lawrence Smith enables us to do with the utmost ease and accuracy. The examination of the alkaline residues spectroscopically was also essentially necessary. The determination of the various constituents was carried out according to the methods given by Fresenius.

In testing the residual silicic acid by boiling with sodium carbonate solution, a great deal of trouble was experienced frequently by its sparing solubility in that reagent. I have not as yet been able to find out why the silicic acid should be quite soluble in some cases and not so in others, when subsequent examination showed it to be equally pure in both cases. For instance, in one specimen of analcime, which had been decomposed with hydrochloric acid, the silicic acid was almost insoluble in sodium carbonate solution; prolonged boiling and using different proportions of water, &c., did not seem to have any effect. On being fused with alkaline carbonate, and separating as usual, it was found to be pure, and was now quite soluble in the sodium carbonate solution.

Another specimen of analcime decomposed by acid gave 55·56 per cent of silicic acid, very sparingly soluble; a fresh portion of the mineral, fused with alkaline carbonate, gave 55·52 per cent of silicic acid, which dissolved in sodium carbonate and gave a clear solution. The difference of time and intensity of heat employed in the ignition of the silicic acid did not seem to affect its solubility. The occasional sparing solubility of silicic acid comes to be of great importance in an analysis of mixed silicates only partially soluble in acids, when, after the acid treatment, the residue is boiled in sodium carbonate solution to extract the separated silicic acid, washed and dried, and the insoluble silicates fused with alkaline carbonate as usual. The silicic acid would be apt to come out too low for the soluble silicates, and too high for the insoluble ones.

Analcime.

	(1).	(2).	(3).
Specific gravity ..	2·153	2·271	2·259
Silicic acid	54·85	54·48	55·54
Alumina	22·59	23·01	22·27
Lime	0·89	—	—
Soda	12·58	14·00	13·75
Water	9·06	8·28	8·55
	99·97	99·77	100·11

No. 1., from vein, Crofthead, Renfrewshire.—The sides of the vein have been first coated with a lime zeolite, probably Thomsonite, the interior having been then filled with analcime. Specimen carefully picked. The alkali consisted solely of soda.

No. 2, from Mugdock Water Tunnel.—Alkali, soda only.

No. 3, Boylstone Quarry, Barrhead.—Alkali, soda only.

Every constituent was at least determined twice. These figures agree fairly with the formula accepted for analcime, $Na_2O,Al_2O_3,Si_4O_8+2Aq$. According to Dr. Odling's arrangement, analcime is a meta-silicate of the spinelle series, in which the ratio of the oxygen of the bases to the oxygen of the silicic acid is as 1 to 2.

Thomsonite.

From the *débris* taken out in blasting the Loch Katrine Water Tunnel, Mugdock.

	Sp. gr., 2·380.
Silicic acid	36·84
Alumina	31·57
Lime	13·54
Soda	4·31
Water	13·54
	99·80

Alkali, soda only. Agrees with the formula given by Dana, $(Na_2Ca'')O_3+Al_6O_9,Si_6O_{12}+7Aq$. An ortho-silicate in which the ratio of the oxygen of the bases to the oxygen of the silicic acid is as 1 to 1.

Natrolite.

From Loch Thom, near Greenock.

Silicic acid	46·29
Alumina	27·10
Soda	15·37
Lime	0·72
Water	10·43
	99·91

Alkali, soda only. The formula is—

$$Na_2O,Al_2O_3,3SiO_2+2aq.$$

A para-silicate, in which the oxygen of the bases is to the oxygen of the silicic acid as 2 to 3.

Stilbite.

From Long Craig, Dumbartonshire. Slight reddish colour. Splinters of this mineral parallel with cleavage planes show very fine colours in polarised light.

	Sp. gr., 2·167.
Silicic acid	57·82
Alumina (containing a little Fe_2O_3)	15·30
Lime	8·12
Soda	0·83
Water	17·85
	99·92

Agrees pretty well with the formula—

$$CaOAl_2O_36SiO_2+6Aq.$$

Alkali, soda, with a trace of potash. A sesqui-silicate, the oxygen being as 1 to 3.

Prehnite.

From Bowling, Dumbartonshire.

	Sp. gr., 2·885.
Silicic acid	43·41
Alumina	24·77
Lime	27·13
Soda	0·27
Water	4·20
	99·78

Formula, $2CaO,Al_2O_32SiO_2+Aq$.

The alkali has been all calculated as soda, but the spectroscope showed lithia distinctly, as also a trace of potash. Every care was taken as to the purity of the chemicals; but, in fact, the carbonate of lime used in the determination of the alkalies was all taken from the same supply. Some of the rock matrix adjoining the mineral was examined, and lithia likewise detected. Two other specimens of rock from near the same locality showed lithia likewise. A specimen of prehnite from Barrhead did not show any lithia.

Dr. Wallace said the subject treated of by Mr. Young had been studied by various chemists, of whom Dr. Odling had carefully classified the zeolites. Smith's process was very useful where the amount of alkali was very small, as in fire-clays, and hence it was most likely to come into general use.

"*On the Decomposition of Sulphate of Potash by Nitrate of Soda*, by William Henderson.

Starting with the assumption that nitrate of potash or nitrate of soda had the power of increasing the solubility of some salts, such as those that are found mixed with them in a crude state—the alkaline sulphates and chlorides—the author, a number of years ago, made some efforts to produce saltpetre from Canadian potashes and nitrate of soda. One of his earliest notes was to the effect that, if nitrate of soda dissolved an increased quantity of sulphate of potash, nitrate of potash might crystallise from

the solution, or decomposition might take place under pressure. After referring to the order of crystallisation of the salts from kelp liquor, the author stated that the experiments were continued, and although there was from 12 to 15 per cent of sulphate of potash in the potashes, or 6 to 8 per cent in the whole materials used, there seemed no indication of saltpetre collecting in the liquors in any marked quantity, or in the residual salts; and it was supposed to be lost in the residual salts, and although found in these, it was not in sufficient quantity to account for the whole. It was then suspected that it was decomposed by the nitrate of soda; and to prove this, equivalents of nitrate of soda and sulphate of potash were dissolved together, and then evaporated till a slight pellicle formed on the surface. The solution was allowed to crystallise for some days, sulphate of soda being found in the crystals, but no saltpetre crystallised until the mother-liquor was evaporated. The following memorandum was made at the time, viz., "that the decomposition might be made perfect, but the conditions under which this may be effected are peculiar." The probable peculiar conditions were sought for, such as some special density of the solution, some stage to which the solution should be "salted" down, or particular temperature at which the liquid should be kept until crystallised. Many trials were made with liquids of varying densities, weak solutions were allowed to evaporate spontaneously, the solution of one salt was gradually added to the other while being evaporated, and then the contrary, but no satisfactory result could be obtained. The experiments were suspended for about two years, and then resumed, and the author was led to the conclusion that there must be something to induce the decomposition desired. Thinking that a larger quantity than an equivalent weight of nitrate of soda might be necessary, he used a double quantity of that salt along with sulphate of potash. The solution was boiled until a quantity of saline matter was thrown down, the clear liquor yielding, in a separate basin, nitrate of potash crystals very readily; and the boiled-down salt was dissolved and gave a distinct crop of sulphate of soda crystals. It thus seemed that only an excess of nitrate of soda was required to begin decomposition, and that the boiling down process would complete it. Quantities of half a ton were then used, keeping the nitrate of soda in excess; but when about two tons of the materials were in process, the operation proved a failure, no decent crop of crude saltpetre being obtained, but, instead, a mixture of sulphate of potash and sulphate of soda thrown down together by the boiling; and instead of getting crystals of saltpetre, there was a mixture of sulphates and nitrates of potash and soda. Referring to the fact that Leblanc's soda process was only successful when lime was used in more than the theoretical quantity, the author said that the idea that the same condition was wanted in the case of the sulphate of potash presented itself; that it was not a slight excess, but a double equivalent, that was *absolutely* necessary. By subsequent experiments, this was fully demonstrated, and sulphate of soda and saltpetre were obtained of excellent quality.

On the suggestion of Mr. Tatlock, the Secretary of the Section, Mr. Henderson tried an equivalent of chloride of sodium instead of the second equivalent of nitrate of soda, and the mixture, on being salted down, was quite successful in yielding a good crop of sulphate of soda, and afterwards nitrate of potash. Mr. Tatlock had noticed, when studying the saltpetre process at Kames gunpowder mills, that, although sulphate of potash was present in small quantity in the muriates used, instead of sulphate appearing, it was always chloride of potassium, while the sulphate of potash was decomposed by the common salt. The decomposition of the sulphate of potash suggested the idea that the more valuable carbonate of potash might be made in the same way from muriate of potash. This was found to be unsuccessful in practice. An experiment was also tried with caustic soda, instead of any of the salts named; double decomposition only took place when the base having the highest equivalent number was separated from the acid having the highest equivalent number. In conclusion, Mr. Henderson said he could not believe that Leblanc's soda process and his own sulphate of potash process were the only instances of such anomalous decompositions as he had referred to, where more than the theoretical quantities of the compounds used were required; and he desired to elicit from the Members whether or not they knew of any similar peculiarity.

Mr. Patterson said he had thought of the process which had been described, but he had gone direct to the kelp liquor with the nitrate of soda, which he had used in slight excess. Large quantities of saltpetre had been made by the process, and the iodine was afterwards obtained in the usual way from the mother-liquor. He had found the temperature had something to do with the order of the decomposition.

Dr. Wallace considered that both temperature and the relative solubilities of the salts used were involved in the successful results of the process.

NOTICES OF BOOKS.

British Metric System. By Isaac Gregory. London: Cassell, Petter, and Galpin. Paris: Hachette et Cie.

The exposition of an ingenious attempt to reconcile the present British weights and measures with the metric system and to pave the way for the introduction of the latter. The author points out that with slight modifications the imperial pound, foot, quart, &c., might be made to rank as members of a metric series. Thus the modified pound would be the half kilogramme, and would be divided into 20 ozs. of 25 grammes each. Its multiples would be the metric stone of 10 lbs., the metric cwt. of 10 stones, and the metric ton of 20 cwts. In this manner he maintains, the public, on the introduction of the new system, would not be left in ignorance of the fair prices of commodities as compared with the old standard. His metric foot differs from the present foot by the $\frac{1}{8}$th part of the present inch. He divides it into 12 metric inches, each of which is equal to $2\frac{1}{2}$ centimetres or 25 millimetres. His metric yard consists of 40 metric inches. He urges that the metric inch, "differing only by about a hair's breadth from the old inch, even tailor's registered measurements, supposed to be the most precise in all non-technical trades, would not suffer. The sizes of paper, books, and engravings would not differ appreciably. The standards for small parts of machines will not differ in quotations by the metric inch."

The objections to the present British system and to the introduction of the metric system, "*pure simple*," as it exists in France, are plainly and lucidly stated in the form of a catechism at the end of the work.

Our readers, many of whom use the metric weights and measures in their scientific investigations will doubtless wish the author good speed in his undertaking. It is much to be regretted that the question of reform in our weights and measures has been made a matter of party-politics; attempts to familiarise the children in our national schools with the decimal system having been officially denounced in Conservative organs.

The Owens College Junior Course of Practical Chemistry. By H. E. Roscoe, F.R.S., and F. Jones. London: Macmillan and Co.

A compact and well arranged manual for experimental study, intended, as we learn from the preface, "not to supplant, but rather to supplement, instruction given by the teacher." There is a clear sketch of the most important blowpipe tests, including Bunsen's flame reactions; next follow tables for the detection and separation of the elementary bodies. We notice with pleasure that

the characteristic reactions of the rarer substances, such as indium, rubidium, and thallium are not omitted. There is also a section on the recognition of the most important and best-characterised organic compounds, such as the vegetable acids, the alkaloids, albumen, starch, sugar, &c.

The work closes with a section of "Questions and Exercises," well devised for enabling the student to test his own progress. The general merit of this little volume makes us regret the more that so large a part of its bulk is occupied with the publishers' catalogue, a kind of addition which we strongly deprecate.

Alizarine, Natural and Artificial. By Fred. Versmann, Ph.D. New York.

This pamphlet, after some needless remarks on the history of the gas manufacture, gives an account of the cultivation of madder. The author tells us, very truly, that the colours obtained from Dutch madder are not fast, and that the "paluds" is the finest French quality. We have next an account of the various commercial preparations of madder, *fleur de garance*, garancine, green alizarine, and extract of madder. Then follows a chapter on the properties, purification, and testing of anthracene, the raw material from which artificial alizarine is obtained. The preparation of the colour is given in detail, together with the proofs of its absolute identity with natural alizarine as obtained from madder. It is interesting that the author pronounces artificial alizarine superior and preferable to the natural from madder, as the latter invariably contains impurities which deteriorate the colours and dirty the white ground of the cloth in printing.

The following passages have, for us, a painful interest:—"England produces immense quantities of benzole, the greatest part of which goes to Germany, there to be converted into aniline dyes, a considerable quantity of which goes back again to England. No other country is so far advanced in the manufacture of the coal-tar colours as Germany. The quantity of alizarine manufactured by the German makers far surpasses the English production." That we should have to import coal-tar colours from any country seems to us nothing less than a national disgrace.

The theoretical yield of alizarine is calculated by the author at one for every 1000 tons of coal converted into gas. Practically it does not exceed half this amount.

The pamphlet concludes with some valuable recipes for printing with artificial alizarine, and for preparing the requisite thickeners and mordants.

Traites des Dérivés de la Houille Applicables a la Production des Matieres Colarantes. Par MM. C. Girard et G. de Laire. Paris: Masson. London: Williams and Norgate.

The important part played by the coal-tar products in modern industry is well evinced by the number and scope of the works devoted to their consideration. The treatise before us must be pronounced a valuable contribution to this branch of chemical technology. The authors are well known to possess an extensive and thoroughly practical acquaintance with the manufacture of aniline colours. Commencing with an enumeration of the bodies produced by the destructive distillation of coal, they take up in detail each one applicable to the preparation of tinctorial substances, and give a full account of its composition, preparation, decompositions, and combinations. Those products which have become of commercial importance are treated at great length; their preparation and purification being described in full detail according to the most improved methods. Diagrams of the needful plant and machinery have been added, carefully drawn to scale. The separation and utilisation of the various residues—a most important point in the manufacture of aniline colours—has not been overlooked. The authors have very judiciously called especial attention to imperfectly known bodies, whose further investigation is likely to prove of interest, theoretical or practical.

Those best acquainted with the wonderful fecundity of organic chemistry will be least surprised to learn that, despite the researches of so many eminent men, such substances are by no means few. The interesting researches of Krouber are given in detail. This chemist, taking eleven kinds of benzine, of which the boiling-points and specific gravities were noted, transformed them successively into nitrobenzines, anilines and magentas, the amount and quality of the yield being in each case registered. It is by such investigations that the manufacture of coal-tar colours will be freed from empiricism and placed on a rational footing.

The preparation of safranine, geranosine, rosanaphthylamine, and other of the recent colours is described. Artificial alizarine, as obtained from anthracene, is omitted. The treatise, it must be remembered, is addressed to the colour-maker rather than to the dyer and printer. Hence prescriptions for the uses of the various colours will not be found in its pages. To all connected with the manufacture of coal-tar products it will prove a most valuable book of reference.

Mikroskopische Untersuchungen der Gespinnst-fasern, &c. Von Dr. R. Schlesinger. Zurich: Orell, Fuessli, and Co.

This work embodies in brief space the results of valuable and prolonged research on the recognition of the fibres met with in commerce. The microscopical and chemical characteristics of each kind employed in textile manufactures are given first in its raw state. The author's tests are sulphuric, nitric, and chromic acids, alcoholic solution of iodine, cuprate of ammonia, dilute potassic hydrate, and sulphate of aniline, the latter to indicate lignification of the fibre. The examination under polarised light is recommended both for vegetable fibres and varieties of silk. Wool, silk, cotton, and linen are next examined when dyed and printed. The reagents recommended are iodine, chromic acid and dilute sulphuric acid, hydrate of soda and cuprate of ammonia, which the author prefers to prepare by dissolving metallic copper in strong liquid ammonia.

The last section is devoted to the detection of shoddy when mixed with fresh materials. The author points out as its characteristics the frequent absence of the scales found upon the fibres of fresh wool, the irregular diameter of the hairs, and their worn and jagged appearance. Shoddy swells up and dissolves in alkaline lye more readily than new wool.

We cannot help expressing our regret that England, the very focus of textile manufactures, must be indebted for such researches to the Continent. The pursuit of abstract truth, much sneered at by our manufacturers, is found abroad to draw after it, in the words of Bacon, "whole squadrons" of valuable practical results.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 20, 1873.

This number opens with the record of the death, on the 18th inst., at Paris, of Baron Charles Dupin, one of the oldest members of the Academy, at the age of 89 years. The deceased has been a member of the Academy since 1818, and was a celebrated physicist and mathematician. The following original papers and memoirs more particularly relating to chemistry are published in this number:—

New Derivatives from Propyl.—A. Cahours.—After first referring to the labours of Chaucel, Pierre, Puchot, and others on propyl, the author describes at length the results of his researches on—Sulphuret of propyl, an oil-like fluid, lighter than water, exhibiting a fœtid odour; sp. gr. at 17°=0·814; boiling-point, from 130° to 135°. This sulphuret yields, when treated with iodide of propyl and some water in a closed vessel, a new body, the formula of which is—

$$C_{18}H_{21}IS_2=\left(\begin{matrix}C_6H_7\\C_6H_7\\C_6H_7\end{matrix}\right)I.$$

Quicksilver propyl is a colourless, mobile fluid; exhibits hardly any smell when cold, but a penetrating smell on being heated; insoluble in water; soluble in ether, and somewhat in alcohol; sp. gr. at 16°=2·124; boiling-point, between 189° and 191°; formula, $Hg(C_6H_7)_2$. Iodide of tri-stanno-propyl, $Sn(C_6H_7)_3I$, boils at about 270°; sp. gr. at 16°=1·692; a colourless liquid which has an irritating effect when poured upon the skin; it forms a hydrated oxide, $Sn(C_6H_7)_3O,HO$, when treated with caustic potassa solution, and the hydrate becomes anhydrous by distillation over caustic baryta. Nitro-propan, $C_6H_7(NO_4)$, is also a liquid; boiling-point, between 125° and 128°; under the influence of nascent hydrogen, this body is converted into propylamine. Nitropropan combines with soda, forming a solid crystalline compound, $C_6H_6Na(NO_4)$.

Apparent|Substitution of Metals for themselves (áeux mêmes) in their Saline Solutions.—F. M. Raoult.—When a cadmium wire is wound spirally on a small plate of gold, and immersed into a boiling and concentrated solution of sulphate of cadmium, that solution is rapidly decomposed, and there is deposited on the gold a firmly-adhering film of cadmium. Chloride of cadmium may be substituted for the sulphate, but the experiment does not succeed with the nitrate. When, instead of a cadmium wire and cadmium solutions, zinc wire and solutions of either sulphate or chloride of zinc are applied, a similar result obtains, zinc being deposited upon the gold; the same obtains when tinfoil is wound round the gold, and the metals immersed in a concentrated and boiling-hot solution of protochloride of tin. Instead of gold, copper may be used; but with gold and iron, nickel, antimony, lead, copper, and silver, such phenomena do not take place. The metals deposited on the gold form with it true alloys, which can only be destroyed by continued boiling with acids.

Some Compounds in which Phosphorus appears to Exist in a Condition Analogous to that of Amorphous Phosphorus.—A. Gautier.—This paper treats at great length on the results of the decomposition of bi-iodide of phosphorus by water in excess. In addition to phosphorous and hypophosphorous acid, there is formed a new body, Ph_5H_3O, a solid substance which is readily converted into phosphorous and phosphoric acids.

Bayerisches Industrie und Gewerbe-Blatt, December, 1872.

Preparation of a Strongly-Decolourising Animal Charcoal.—Dr. Graeger.—The common powdered bone-black is first mixed with from four to six times its bulk of a solution of from 4 to 5 per cent of crystallised carbonate of soda, and boiled therewith for some time; next it is washed by decantation, and, after that, treated with a large excess of dilute hydrochloric acid, sufficient, not only to dissolve the carbonate, but also the phosphate of lime it contains. (In order to see whether enough acid had been added, a small sample of the previously-filtered fluid is tested by means of ammonia, which, when added in slight excess, should not produce a turbidity.) When the mineral matter is removed, the charcoal is thoroughly washed, first by decantation, and next placed on a filter and washed until the water exhibits no acid reaction; the material is then carefully dried at from 100° to 120°. 100 parts of crude animal charcoal yield 20 of the purified, which has highly decolourising properties. The method requires time and patience.

Preparation of an Indelible Ink for Marking Linen and Cotton Fabrics.——Dr. Bottger.—It appears that the juice of the Anacardium nut (*Anacardium orientale*) contains an oily matter, which, by exposure to air, gradually assumes an intense black colour; this colour is neither acted upon by acids, alkalies, chlorine, or cyanide of potassium. The previously pulverised nut is treated in a closed glass vessel with petroleum ether (benzoline), and, having been digested therewith for some time, the fluid is left exposed to air for spontaneous evaporation. The remaining somewhat thickish fluid is used for the purpose of either writing or stamping, by the aid of an engraved dye, upon linen or cotton. At first the colour is dirty brown, but it becomes gradually intensely black, an effect instantaneously brought about by moistening the linen or cotton with liquid ammonia.

European Paraffin Oil.—Dr. G. Feichtinger.—It appears that, in Galicia, large quantities of the petroleum (in every respect like the American) occur, and, according to the investigation made by competent engineers, the country alluded to will soon be able to compete with the foreign trade in this article. Well-boring is actively pursued in several localities, but none have as yet reached the main oil-bearing strata, which are known to be at depths varying from 1000 to 1500 feet below the surface.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 26, 1872.

This number contains no papers relating to chemistry.

Les Mondes, January 23, 1873.

Contains no papers relating to chemistry.

La Revue Scientifique de la France et de l'Etranger, January 25, 1873.

This number contains no original matter relating to chemistry, but we call attention to the following papers:—

Report on the Conservatoire des Arts et Métiers.—General Morin.—This paper, addressed to the Minister of Agriculture and Commerce, contains a succinct, yet interesting, history of the institution alluded to, originally founded by the celebrated Vaucanson, who, during the reign of Louis XVI., was Inspector-General of Manufactures. The Conservatoire des Arts et Métiers, as now existing, owes its organisation to the first French Republic. The lectures given at this institution are chiefly attended by working men, and the subjects taught are sciences in their application to industry, including mathematical as well as economico-political sciences.

Development of the Human Race.—Dr. Schaaffhausen.—An interesting lecture on this subject.

Bibliography.—Under this heading, we quote the titles of the following works:—"Annuaire du Bureau des Longitudes pour l'An 1873, avec Notices Scientifiques," 1 vol. (Paris: Gauthier-Villars); this small volume contains a large amount of generally useful information. "Cours de Chimie Agricole, Professé à l'Ecole d'Agriculture de Grigaon," par P. P. Dehérain (Paris: Hachette and Co.) This work is highly spoken of, and appears to contain a large amount of useful and practical information.

Bulletin de la Societe Imperiale des Naturalistes de Moscou, No. 2. 1872.

This number contains the continuation of the following exhaustive monograph:—

The Compounds of Ilmenium and Niobium, and the Composition of the Niobium Minerals.—R. Hermann.—This portion contains the following sections:—Atomic weight of ilmenium, found to be=654·7; sp. gr. of ilmenium=5·97; atomic volume of ilmenium=109·6; oxides of ilmenium, viz., brown, green, and blue; ilmenic acid ($\underline{\dddot{Il}}$); hypo-ilmenic acid ($\underline{\ddot{Il}}$); hypo-ilmenic-ilmenic acid ($\ddot{Il}\,\dddot{Il}$); sulphuret of ilmenium; chloride of ilmenium ($Il_2\underline{Cl}_3$); fluoride of ilmenium; combination of ilmenium and potassium fluoride—

$$(2K\underline{Fl}+Il_2\underline{Fl}_3+\underline{\dot{H}});$$

hypo-ilmenium (*unterilmen*) potassium fluoride ($\underline{K}Fl+Il\underline{Fl}_2+\underline{\dot{H}}$;. ilmenium and potassium; ilmenium and sodium; compounds of the ilmenic acids with soda; ilmenate of soda ($\dot{Na}\underline{\dddot{Il}}+7\underline{\dot{H}}$), *ilminiges unter-ilmen saures Natron*; ilmenious ilmenate of soda ($\dot{Na}_2\underline{\dddot{Il}}\,\ddot{Il}_2+13\underline{\dot{H}}$) hypo-ilmenate of soda ($\dot{Na}_2\ddot{Il}_3+12\underline{\dot{H}}$); composition of the niobium minerals; stœchiometrical constitution of the niobium minerals; crystalline shape of the niobium minerals; homoomorphy and heteromery of the niobium minerals and niobium fluorides; enumeration and description (mineralogico-chemical) of the different niobium minerals.

Annales de Chimie et de Physique, January, 1873.

This number contains the following original memoirs relating to chemistry:—

The Spectra of the Metalloids.—Dr. G. Salet.—Illustrated by engravings.

New Studies on Propionic Acid.—I. Pierre and E. Puchot.—The contents of this exhaustive memoir may be summarised as follows:—When propionic acid has been brought to its greatest degree of concentration, it contains the elements of an equivalent of water which cannot be driven off by further distillation. The formula of this acid is $C_6H_6O_4=C_6H_5O_3,HO$. The boiling-point of this acid is 141·5° at 0·76 barom. The sp. gr. at 0° is =1·0143. The propionate of baryta, crystallising at from 20° to 25°, contains one equivalent of water of crystallisation, and its formula is $C_6H_5O_3,BaO,HO$. The formula of the crystallised propionate of silver (anhydrous salt) is $C_6H_5O_3AgO$.

Action which Silica and some Analogous Oxides exert upon Carbonate of Soda at a High Temperature.—E. Mallard.—This exhaustive essay treats, in the first place, on the action of high temperatures upon carbonate of soda alone, and further contains the following sections. Action of silica upon carbonate of soda; action of titanic acid; alumina; sesquioxide of iron; boracic acid.

Description of a Constant Level Apparatus for the purpose of Silver Assays by the Wet Way.—G. Sire.—This memoir, illustrated by woodcuts, contains the description of a contrivance for keeping the salt solution used in the process alluded to at a constant level.

Water is not Decomposed by the Electric Current during the Electrolysis of other Substances.—E. Bourgoin.

Detection and Quantitative Estimation of the Combined Carbon Present in Meteoric Iron.—J. Boussingault.—The author's researches have been made with the view to ascertain whether the meteoric iron contains combined carbon in the same condition as obtains in pig-iron and steel. The meteoric iron of Caille (Alpes Maritimes) was found to contain 0·12 per cent of combined car-

bon; and further to consist in 100 parts of:—Iron, 89·53; nickel, 9·76; insoluble in acids, 0·59. The meteoric iron from Lenarto (Hungary) was found to consist in 100 parts:—Iron, 91·50; nickel, 8·58; copper, a trace, carbon and sulphur, none; insoluble, 0·30.

February, 1873.

This number contains no original papers relating to chemistry, but we meet here with several algebraico-physical essays relating to electricity, galvanism, and magnetism.

NOTES AND QUERIES.

Coralline and Blackley Red.—(Reply to P. Burrows).—Coralline is obtained by the action of oxalic and sulphuric acids upon phenol. You will find ample information on this and the other substance you mention in Girard and De Laire's recently published work, quoted in a previous number of the Chemical News, and also in Dr. Elsner's "Chemisch-Technische Mittheilungen" for 1871-72, p. 84. This work can be inspected at the Patent Office Library.

MEETINGS FOR THE WEEK.

Monday, Feb. 3rd.—Medical, 8.
—— Royal Institution, 3. (General Monthly Meeting.)
Tuesday, 4th.—Civil Engineers, 8.
—— Anthropological, 8
—— Zoological, 8½.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
Wednesday, 5th.—Society of Arts, 8.
—— London Institution, 7.
—— Geological, 8.
—— Microscopical, 8. (Anniversary.)
—— Pharmaceutical, 8.
Thursday, 6th.—Royal, 8½.
—— Chemical, 8. W. H. Perkin, "On Anthrapurpurine." Dr. C. R. A. Wright, "Isomerism in the Terpene Family of Hydrocarbons." R. S. Dale and C. Schorlemmer, "On Aurine."
—— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
—— Royal Society Club, 6.
Friday, 7th.—Geologists' Association, 7½. (Anniversary.)
—— Royal Institution, 9. Prof. Ramsay, "Old Continents."
Saturday, Feb. 8th.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3956. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of maize and other like grain for the production of starch therefrom, and in the utilisation of the waste products for the manufacture of cardboard and paper, and for the preparation of soaps."—A communication from E. Leconte, Paris.—Petition recorded December 30, 1872.

35. W. B. Stephens, Strand, Westminster, "Improvements in the manufacture of paints."—Petition recorded January 3, 1873.

154. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the treatment of sewage, and of the deposits obtained therefrom."—Petition recorded January 14, 1873.

168. J. L. F. Target, Portsdown Road, Middlesex, "Improvements in treating excreta and sewage matters, and in apparatus employed therein, parts of the apparatus being also applicable to the drying and charring of other matters."—Petition recorded January 15, 1873.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLTE SPECIFICATIONS.

213. G. Haseltine, Southampton Buildings, London, "Improvements in the manufacture of white-lead, and in the purification of carbonic acid gas used in the said manufacture, and in apparatus therefor."—A communication from A. P. Meylert, New Britain, Conn., U.S.A.

216. L. Stevens, Washington, D.C., U.S.A., "A process for forming carbonic oxide from oxyhydrogen vapour or steam, and an apparatus for utilising the same for heating purposes."—Petitions recorded January 18, 1873.

NOTICES TO PROCEED.

2704. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphate of soda."—Petition recorded September 12, 1872.

2801. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Petition recorded September 21, 1872.

3067. W. Morgan-Brown, Southampton Buildings, London, "An improved composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables."—A communication from F. O. Möller, Rue Lavoisier, Paris.—Petition recorded October 17, 1872.

3930. B. White and P. T. Hendry, Glasgow, N.B., "Improvements in treating liquids to be burned for illuminating purposes."—A communication from J. Hall, jun., Cincinnati, U.S.A.—Petition recorded December 27, 1872.

3957. J. W. Spencer, Newcastle-on-Tyne, "Improvements in the production of iron."—Petition recorded December 30, 1872.

3968. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of steel, and in apparatus employed for this purpose."—A communication from T. R. Scowden, Cincinnati, U.S.A.—Petition recorded December 31, 1872.

THE CHEMICAL NEWS.

VOL. XXVII. No. 689.

THE ADULTERATION ACT.

It was naturally supposed when the new Adulteration Act was passed that the fraudulent admixture of substances with articles of food and medicine would be abolished, by reason of the offence being made criminal, and by the fact that duly qualified men were expressly to be appointed as analysts, to whom articles of food, &c., were to be submitted for examination. This has now proved a delusion; in the first place it is necessary to the working of the new law that duly qualified chemists be appointed. Such a man would be one who had studied chemistry at some University or recognised School of Science, and had been engaged in all kinds of analytical work or scientific research daily for at least four years previous to his appointment. If an adulterated substance be put for analysis into the hands of a man wanting in the amount and nature of the experience thus indicated, a trustworthy report cannot be expected, and either the offender may escape conviction or the innocent may be unjustly accused of a criminal offence. What is actually the state of things just now? Out of many appointments already made, not more than two or three are filled by persons having the necessary knowledge their duties require. It is a positive fact that some of these men are endeavouring to get a few private lessons in chemistry, vainly imagining that they may, by the help of a book and a few hints scraped together, be able to make some pretence of work. The vestries for the sake of economy offer a paltry £100 or £150 a year to the salary of their medical officers to undertake the analyses. Now what is, generally speaking, the scientific experience of these gentlemen? At a remote period of their student days they were required to be present at not more than sixty chemical lectures, and sixty hours of the most elementary laboratory practice: in such work boys in the Grammar Schools of Birmingham and Manchester could excel them. Even the little knowledge then gained has by this time faded away, and they could not, off-hand, establish the difference between sulphate of zinc and Epsom salts, much less the presence of alum in bread or bromide in iodide of potassium. Adulterators may continue their evil practices relying in cases where detection may ensue that the criticism of an able chemist will so damage the evidence as to render conviction impossible. A humbling picture of a Local Government Board engaged in electing an analyst was lately afforded by a report of the proceedings in a recent copy of the *Times*. The request of the medical man that he should be authorised to spend not more than £100 in fitting up a laboratory with the necessary apparatus for his chemical work was "received with much laughter." A vestryman stated that he possessed a laboratory in which he could do almost anything which cost only 20s. The analysts should be appointed by Government: it is hardly to be expected that vestrymen will encourage competent persons to produce evidence damaging possibly to some of their own body. It is disgraceful that a parliamentary measure of such good intentions should be made a farce, and we recommend that a statement of how the matter at present stands be forwarded by the Chemical Society to Mr. Stansfeld.

DEHYDRATION (WASSERENTZIEHUNG) IN THE LIVING ANIMAL ORGANISM.

By M. NENCKI.

In consequence of the discovery made by Voit that there exists in the living animal organism an equilibrium of nitrogen (*Stickstoffgleichgewicht*), so that nearly all the nitrogen taken up as food is eliminated from the body in the shape of urea, it has become the custom to view the animal body as almost exclusively an oxidising agent, and upon this view have been based calculations—such as those on the combustion-heat generated in the animal body—which, as this view does not apply to the vegetable reducing bodies (*reducirenden planzenkörper*), cannot be correct.

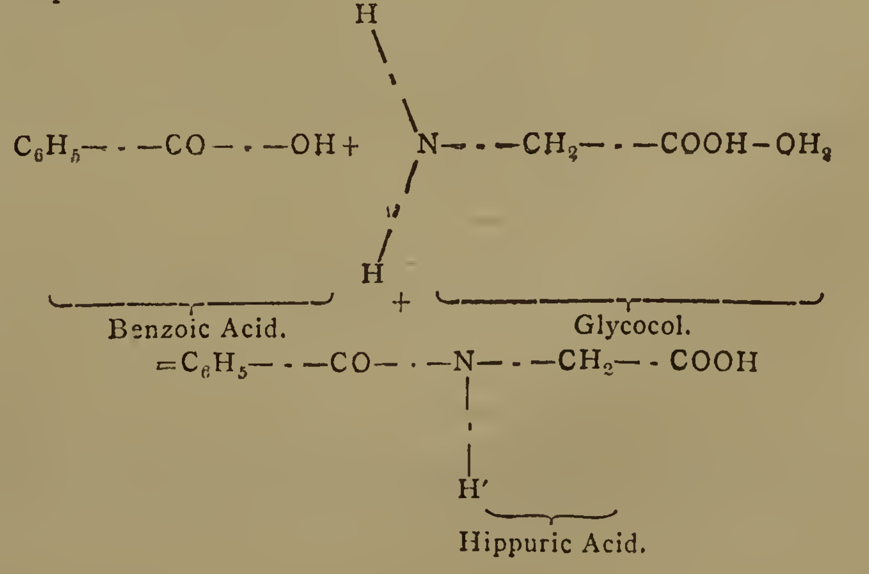
Liebig has recently observed (*Ann. d. Chem. u. Pharm.*, vol. cliii., p. 173) that the researches made by Dr. Frankland on the heat of combustion yielded by the substances used as food are correct for ascertaining the heat which these substances will yield when used as fuel in the furnace of a steam-boiler, but are of little, if any, value in respect to the valuation of the heat yielded by them in the living body.

Later researches have, moreover, proved that, simultaneously with oxidising processes, there are going on in the living animal organism other processes, which we are accustomed to view as the opposite of oxidation, and these should be taken into account in making calculations. The formation of benzoic from quinic acid in the living animal organism is due to a reduction, as is also the conversion of bilirubin into pigment of urine, as lately discovered by Maly.

Baeyer (*Ber. d. Deutsch. Chem. Gesells.*, 1870, p. 63) has published his researches on the possible cases of dehydration of combinations consisting of C, H, and O, and has thence deducted the two reactions which take place after dehydration or withdrawal of water, viz., (1) formation of anhydride, and (2) condensation. The importance of this process in the life of plants, as pointed out by Baeyer, has been confirmed by his recent researches on a new class of dyes which, in many respects, closely agree with those occurring naturally.

It is my intention to give a review of the facts relating to dehydration as recent researches have shown to be going on in the animal body, and there can be no doubt that a correct knowledge of these facts is of high importance.

While the N and the C of the albuminates used as food are probably only held together by one affinity—which is certainly the case with their immediate products of splitting up, viz., the preliminaries or preceders (*vorstufen*) of urea (leucin, glycocol) which occur only in that form—we frequently find combinations in the animal body the origin and presence of which is due to elimination of water (*wasseraustritt*), and in these compounds the N is chiefly fixed as C— - —N— - —C, but also as C☰☰N, to C. This double or triple fixation of N to C, which occurs after the elimination of water (formation of amide or nitrile), may be viewed as condensation, and is then analogous to the compounds resulting from elimination of water from the C, H, and O combinations. Thus the formation of hippuric acid and other aromatic glycocol compounds in the organism is due to withdrawal or elimination of water, and after that has taken place the N is fixed with two affinities to the C, analogous to the outer (*äusseren*) condensation of the C, H, and O compounds—



The formation within the organism of the duplicate gall acids, the glyco- and tauro-cholic acids, is based upon the same reaction—

$$\underbrace{C_{23}H_{39}O_3\text{---}CO.OH}_{\text{Cholalic Acid.}} + \underbrace{N\begin{cases}H\\ H\end{cases}\text{---}CH_2\text{---}COOH}_{\text{Glycocol.}} - OH_2 = C_{26}H_{43}NO_6$$

The withdrawal of water in non-nitrogenous substances is at present only known in one instance, with formation of anhydride, viz., in the conversion of grape sugar into glycogen. According to researches made by Dr. Schöpfer* in the laboratory at Bern, which fully confirm the exhaustive ones of Dr. Bernard on this subject, solutions containing 15 per cent of grape sugar, and, injected into the branches of the vena portarum, are retained by the liver, while, if the same solution is injected in any other vein of the body, two-thirds of the sugar injected is emitted with the urine. Dr. Schöpfer calculated from his experiments that the liver of a medium-sized rabbit can in one minute convert about 0·12 grm. of sugar. It is scarcely possible to assume that the sugar should not be retained in the shape of glycogen, since I have found that when substances containing sugar have been given as food, the blood of the vena portarum always contains sugar, while glycogen is simultaneously largely generated in the liver. The formation of the cholesterine of wax, and that of the fats from carbohydrates in the animal organism, can only be explained by the elimination of O in the shape of OH_2, aided by a partial oxidation of the original substance.

We most frequently meet with water elimination in the animal organism, in the last members of the so-called regressive metamorphosis, but this may be accidental, on account of the constitution of the substances belonging to that class of bodies having been relatively most thoroughly studied. The N of the food is chiefly eliminated from the body in the shape of urea, and next as kreatine, uric acid, xanthine, guanine, and other substances belonging to the uric acid group. The origin of these substances is due to elimination of water, as may be elucidated by the general formation formula—$mCO + nCO_2 + NH_3 - pH_2O$. Dr. Schultzen's recent researches have clearly explained the formation of urea in the animal body—

$$\underbrace{NH_2\text{---}CO\text{---}O\text{---}NH_4}_{\text{Carbaminate of Ammonia.}} - OH_2 = \underbrace{NH_2\text{---}CO\text{---}NH_2}_{\text{Urea.}}$$

It is evident that the attempts to convert albuminous substances by direct oxidation into urea are in a physiological sense quite useless, since the formation of urea in the animal body is based upon totally different processes. As proved by the synthesis of kreatine by Dr. Volhard, the elimination of water has in this instance proceeded as far as the formation of cyanamide (nitrile of carbaminic acid). In this case the cyanamide is simply added to the sarkosine, as the cyanogen is to the barbituric acid, and the cyanuric acid to the amido-groups of the uramile in the formation of pseudo-uric acid—

$$\underbrace{NH\begin{cases}CH_3\\ CH_2\end{cases}\text{---}COOH}_{\text{Sarkosine.}} + CN_2H_2 = \underbrace{=CN_2H_2NH\begin{cases}CH_3\\ CH_2\end{cases}\text{---}COOH}_{\text{Kreatine.}}$$

$$\underbrace{C_3H\begin{cases}NH_2\\ O_2\end{cases}\text{---}CON_2H_2}_{\text{Uramile.}} + CNOH = \underbrace{=C_3H\begin{cases}NH_2CONH\\ O_2\text{---}CON_2H_2\end{cases}}_{\text{Pseudo-Uric Acid.}}$$

We may take it for granted that the formation of kreatine in the organism takes place, as it does when artificially produced, by the combination of cyanamide with sarkosine. According to Schultzen's investigations, the sarkosine used as food combines, with elimination of OH_2, with the elements of carbaminic acid. The reason why the sarkosine is not all eliminated from the animal organism as kreatine is doubtless in a great measure due to the large accumulation of the former in the organism; the daily quantity of kreatinine emitted with urine, and derived from kreatine, amounts in human beings to from 0·6 to 1·3 grms. It is, however, probable that under normal conditions a small quantity of urea eliminates in certain parts of the organism another molecule of H_2O, and that the cyanamide thus formed combines with sarkosine to form kreatine.

The Schultzen's substance is not the only one which, after the use of sarkosine as food, is met with as sarkosine instead of urea in the urine, and it will be highly interesting to ascertain how the secretion of kreatine, and also of kreatinine, stands when sarkosine is used as food. The formation of uric acid, xanthine, and sarkine in the human body is doubtless based upon similar processes. In uric acid, at least, the most probable constitutional formulæ would indicate the presence of the cyanamide group, and it is just by proving the dehydration in the process of the formation of these bodies in the organism that the main interest of the artificial preparation of uric acid is based. The investigations and experiments of many scientific chemists engaged in this direction will in all probability add largely to our knowledge of this subject. —*Ber. d. Deutsch. Chem. Gesells.*

* "Beiträge zur Keuntniss der Glykogenbildung in der Leber," von Dr. E. Schöpfer. Inaugural Dissertation; Bern, 1872.

ON THE

COMPOSITION AND ORIGIN OF THE WATERS OF A SALT SPRING IN HUEL SEATON MINE, WITH A CHEMICAL AND MICROSCOPICAL EXAMINATION OF CERTAIN ROCKS IN ITS VICINITY.*

By J. ARTHUR PHILLIPS, Mem. Inst. C.E.

Huel Seton Copper Mine is situated about one mile north-east of the town of Camborne, Cornwall, and is distant from the sea, on the north coast, a little more than 3 miles.

* Abstract of a Paper read before the Royal Society, January 30.

The workings of Huel Seton are entirely in "killas," or clay-state, and the saline waters issue at the rate of 50 gallons per minute, and at a temperature of 92° F., from the eastern fore-breast of the 160-fathom level. This has intersected a fault, or cross-course, which may be traced in a northerly direction to the sea. The temperature of the level from the end of which the water issues, like that of the water itself, is 92° F. The following results, in grammes per litre and grains per gallon, were obtained by analysis. Sp. gr., 1·0123. Total solid contents, 14·3658 grms. per litre, or 1005·61 grains per gallon.

	Grammes per litre. I.	Grammes per litre. II.	Grains per gallon. I.	Grains per gallon. II.
Carbonic acid	0·0795	0·0786	5·56	5·50
Sulphuric acid	0·0178	0·0177	1·25	1·24
Silica	0·0270	0·0280	1·89	1·96
Chlorine	9·1728	9·1662	642·10	641·63
Bromine	trace	trace	trace	trace
Alumina	0·3456	0·3460	24·19	24·22
Ferric oxide	0·0031	0·0033	0·22	0·23
Manganese	trace	trace	trace	trace
Copper	minute trace	minute trace	minute trace	minute trace
Lime	3·4795	3·4963	243·56	244·74
Magnesia	0·0721	0·0710	5·05	4·97
Alkaline chlorides	6·4920	6·4626	454·44	452·38
Potassium	0·0832	0·0835	5·82	5·84
Cæsium*	trace	trace	trace	trace
Sodium	2·2977	2·2885	160·84	160·19
Lithium	0·0805	0·0794	5·63	5·56
Ammonia	trace	trace	trace	trace
Nitric acid	trace	trace	trace	trace

The foregoing results may be thus tabulated †:—

	Grammes per litre. I.	Grammes per litre. II.	Grains per gallon. I.	Grains per gallon. II.
Calcium carbonate	0·0921	0·1011	6·45	7·08
Ferrous carbonate	0·0045	0·0047	0·31	0·33
Manganous carbonate	trace	trace	trace	trace
Calcium sulphate	0·0303	0·0301	2·12	2·11
Cupric chloride	minute trace	minute trace	minute trace	minute trace
Calcium chloride	6·7697	6·7934	473·88	475·54
Magnesium chloride	0·1712	0·1686	11·98	11·80
Aluminium chloride	0·9003	0·9013	63·02	63·09
Potassium chloride	0·0919	0·0900	6·43	6·30
Calcium chloride	trace	trace	trace	trace
Sodium chloride	5·8442	5·8210	409·09	407·47
Lithium chloride	0·4888	0·4820	34·22	33·74
Potassium bromide	trace	trace	trace	trace
Potassium silicate (K_2SiO_3)	0·0693	0·0719	4·85	5·03
Nitric acid	trace	trace	trace	trace
Ammonia	trace	trace	trace	trace
Total found by addition of constituents	14·4623	14·4641	1012·35	1012·49
Total found directly‡	14·3658	—	1005·61	—
Free carbonic acid	0·0373	0·0323	2·61	2·26

A consideration of the various phenomena connected with the occurrence of this and other apparently similar springs, which have at different times been discovered in the district, would seem to lead to the inference that they all have some more or less direct communication with the sea, and that they are either the result of infiltration of sea-water through faults, or are true and independent sources which, before being tapped below the sea-level, had found their way to the ocean through faults or channels.

The following would appear, in the present state of our knowledge, a not improbable explanation of the origin of the Huel Seton spring.

The cross-course is believed to extend through both granite and clay-slate to the sea. From the close contact of its surfaces, the presence of clay, and from other causes, this fault may be supposed not to be uniformly permeable by water, which can only follow a circuitous passage. In this way it penetrates to depths where reactions take place, which, although not entirely in accordance with the results of daily experience in our laboratories, can, after the investigations of M. Daubrée, M. de Sénarmont, and others, be readily understood.

By the action of sea-water on silicates of calcium, silicates of sodium and chloride of calcium may be produced. The sulphate of sodium of the sea-water will be decomposed by this chloride of calcium, with the production of sulphate of calcium and chloride of sodium. The decomposition of clayey matter by common salt may produce chloride of aluminium and silicates of sodium, while the magnesium of the chloride of magnesium may be replaced by calcium; lastly, a portion of the potassium in the sea-water appears to have been replaced by the lithium of the granite.

* The amount of cæsium appears to be very small. On adding chloride of platinum to a rather dilute solution of the alkaline chlorides obtained from this water, a slight yellow precipitate was deposited; this, after re-solution and the removal of the platinum by sulphuretted hydrogen, afforded by the spectroscope somewhat faint indications of the presence of cæsium.

† As the state of combination in which the various substances present in mineral waters exist cannot be accurately determined, the system of grouping adopted in the table must to some extent be regarded as arbitrary.

‡ The difference between the amount of total solid contents found directly and that obtained by addition of constituents, is doubtless in a great measure due to the partial decomposition of aluminium and magnesium chlorides at the temperature (180° C.) at which the drying of the residue was effected.

RESEARCHES ON THE NATURAL PRODUCTION OF NITRATES AND NITRITES. APPLICATION OF MINERAL MANURE TO HORTICULTURE.

By J. JEANNEL.

Many phytophysiologists and horticulturists believe that it is impossible to grow plants in a sterile soil by means of artificial food composed of mineral substances dissolved in water. My aim is to prove by experiments, the results of which I shall presently describe, that:—(1). Nitrates or nitrites are naturally formed in soil containing organic vegetable matter when in contact with air. (2). That it is possible to feed plants with solutions of mineral compounds suitably prepared, so that the plants receive from these solutions the mineral constituents they require, and may thus grow more vigorously even in pure sand than in the best garden-mould.

This opinion was put forth in 1856 by Boussingault while experimenting on the growth of the *Helianthus*. The eminent *savant* then said that the plant assimilates the mineral substances, and need not necessarily be placed in a soil containing decaying organic matter. And this opinion is also confirmed by the experiments of G. Ville, which prove the importance of chemical manures in agriculture. I have utilised the opinions of Boussingault, Millon, and Schœnbein on the natural production of the oxygen compounds of nitrogen; and at the same time have somewhat modified them. I first studied the natural conditions of the formation of nitrates in arable soil, without the intervention of ammonia, simply from the elements of air and the reduction of these nitrates by humus. I applied Schœnbein's reagent (solution of iodised starch acidulated with sulphuric acid), which strikes a blue colour in the presence of nitrites. By the aid of this reagent I ascertained the following facts.

When arable soil or garden-mould is well washed in a displacing apparatus with pure distilled water, that fluid always exhibits the presence of nitrites. It is, however, necessary to use—for the complete removal of the nitrites

from the soil—about twelve times the quantity by weight of distilled water to the weight of the soil experimented upon. The soil thus treated having been again dried, yields, after a short time, nitrites, as indicated by Schœnbein's test in the water employed a second time for exhausting the soil. Sandy soils, and all those which do not effervesce when treated with acids, do not recover nitrites after being dried unless carbonate of lime is added, and the soil then moistened with water and again dried, and lastly washed with distilled water, which then exhibits the reaction for nitrites.

When a solution of the nitrates of potassa and ammonia at $\frac{5}{1000}$ is made to pass through the arable soil or garden-mould previously well washed with water, the soils being placed in a displacement apparatus,it will be found (as I also ascertained) that the nitrates are retained in the soil. 1 kilo. of the soils—which require to be moistened with about half their weight of water—retains about four-fifths of the soluble salts contained in the first litre of the saline solution at $\frac{5}{1000}$, which is poured on to the soils. Nitrate of ammonia is retained by the soil in larger proportion than nitrate of potassa. The alkaline nitrates are in 24 hours reduced to nitrates when in contact with dead leaves, straw, or humus. That reduction is so marked that when dead leaves are washed with distilled water, the leaves distinctly exhibit, with Schœnbein's reagent, the presence of nitrites, due to the nitrates naturally present in the well-water of Paris. These facts appear to me to lead to the following conclusions:—

(1). Soils containing humus and lime determine, while drying, the combination of the elements of the air, without any intervention of ammonia, so that either nitric or nitrous acids are formed, which are at once fixed by the lime. This explains, not only the sterility of soils void of lime and of peat-bogs, but also the utility of liming the soils.

(2). The nitrate of ammonia contained in rain-water and in dew (Millon and Schœnbein) is retained by the humus in the upper layer of the soil, with the nitrites constantly formed in the well-aërated and limed soil, according to the conditions of the atmospheric moisture or dryness.

(3). This constant formation and renovation of the oxygen compounds of nitrogen in soil containing lime and humus is a fact of great importance, which explains the exceptional fertility of the soil in alternate wet and dry weather, when frequent showers of rain are followed by great heat, as was the case in 1872 (in France, at least). It also, in connection with the great affinity of the humus for soluble salts, more especially ammoniacal, accounts for the accumulation of fertilising principles in fallow lands, and at the same time shows the utility of mechanical operations in the soil, such as ploughing, digging, harrowing, &c., by which means contact with the air is increased and free access of air promoted. I have tried to elucidate these theories by a series of different horticultural experiments, specimens of which I send to the Academy.

I. *Comparison between Plants Grown in Sand and in Garden Mould.*—The plants placed in sand have been supplied every week, in addition to receiving ordinary water, with a solution of some decigrammes of mineral manure dissolved in water. The plants placed in garden-mould have only had common water. The pots were placed on saucers, in order to prevent loss of soluble salts. I exhibit, as specimens of this experiment, two plants of the *Pelargonium zonale* and two of the *Agave corniculata*, which in April last were all in the same stage of development. The *Pelargonium* grown in the sand is four times as much developed as that grown in the garden-mould, and has been constantly in bloom during the summer; the *Agave* grown in the sand is twice as large as that grown in the garden-mould.

II. *Plants Grown only in Sand;* but some watered with common water only, others with the mineral solution, once a week.—I exhibit here, as specimens, several *Arum italicum*, and state that I have, during the summer, made a large number of similar experiments with plants belonging to different natural families, such as *Begonias*, *Trandentias*, *Veronicas*, &c. The plants grown without the addition of mineral manure are either dead or drooping, while those raised with the addition of that manure have grown magnificently.

III. *Plants Grown only in Garden-Mould*, to some of which only common water has been given, and to others, in addition to that fluid, a quantity of the mineral manure solution has been supplied weekly.—As a specimen of the result of this experiment, I exhibit two specimens of *Sedum acre*, the plant which has received weekly 2 decigrms. of the mineral manure solution having grown twice as much as the other.

IV. *Plants which have remained for Two Consecutive Years in the same Soil in Pots.*—These, as far as they have been treated with my mineral manure, have grown so well that their size is altogether out of proportion with the pots which contain them. As samples, I exhibit an *Aspidistria elatior* and an *Arum esculentum*.

The mineral manure which I use is made up according to the results of elementary analysis of wheat and of farm-yard manure, taking into consideration that the arable soil, containing organic matter, acts constantly as a nitre-bed, and thus fixes the elements of the air into combination. The manure consists of the following ingredients:—

Nitrate of ammonia	400	parts.
Nitrate of potassa	250	,,
Biphosphate of ammonia ..	200	,,
Chloride of ammonium ..	50	,,
Sulphate of lime (gypsum)	60	,,
Sulphate of iron	40	,,
	1000	

The salts should be pulverised separately, and then intimately mixed. I apply this manure in the following manner:—Dissolve 4 grms. in a litre of water; give to the plants, according to their state of development, every week from 25 to 150 grms. of this solution (equal to from 1 to 6 decigrms. of the salt in solid state).

Conclusions.—(1). Plants can be fed by means of artificially-made mineral solutions. (2). Horticulture may greatly profit by this mode of growing plants, because it renders re-potting unnecessary, and because the nature of the soil becomes a matter of entire indifference, provided it offers to the plants a proper and sufficiently permeable hold; while, lastly, the plants can be fed at will and when most convenient.—*Comptes Rendus.*

ON THE COMPOSITION OF THE LYES WHICH ARE OBTAINED BY THE OXIDATION AND LIXIVIATION OF SODA WASTE FOR THE RECOVERY OF SULPHUR.*

By C. STAHLSCHMIDT.

The soda waste is worked for sulphur on a large scale according to two chief methods, which do not materially differ as to the principle. The first was introduced by Guckelberger and Mond, the second by Schaffner. Both methods are frequently combined, adapted to the circumstances; after thoroughly testing both, the best features of each have been chosen and retained.

Before entering into the examination of the sulphur lye, I wlll give a cursory description of the manner in which the lyes which I examined were obtained, and of the preparation of sulphur therefrom. The method to be described is employed in the Rhenania chemical works at Stollberg (near Aix-la-Chapelle), from where I obtained the lyes.

* Translated by M. Alsberg, Ph.D. From *Dingler's Polytech. Journal*, vol. 205, No. 3.

The soda waste is brought directly away from the lixiviating vats into the oxidising tanks, four of which are connected to one system and are otherwise arranged like soda lixiviating tanks. The size of the tanks varies in the different systems, some are 4 feet by 8 feet, others 8 by 8, and 8 by 16. The tanks have a double perforated bottom and the space between the two is connected by a pipe and register, for regulating the quantity of air, with the air main. The soda waste having been filled into the tanks is oxidised, during 12 to 16 hours, by forcing air through it, which is furnished by a ventilator, and has a pressure of 4 millim. water, and lixiviated with weak lye from a preceding operation; this oxidation and lixiviation is repeated five or six times. Finally the tank is filled with pure water, emptied and filled with fresh waste. By this systematic lixiviation the liquor is brought to 10°—12° B.; it is run off into clarifying vats, from which it passes into the apparatus for decomposition. The latter is a large, round, wooden tank, lined with lead, closed with an air-tight cover, having a large pipe for carrying off the gases and a stuffing box for the shaft of the stirrer; the pipe is connected with a chimney. On one side of the tank, about one foot from the cover, are the pipes for lye and muriatic acid; on the other side, at a distance above the bottom equal to one-third of the height of the tank, a two-inch pipe for drawing off the sulphur suspended in the decomposed lye. By means of a steam pipe the contents can be heated to 60° C. by direct steam. At different heights of the tank there are small cocks, by which samples are drawn off in order to ascertain the necessary amount of acid. Lye and acid of 20° B., in the proportion of 8 : 1 to 7 : 1, are alternately run into the tank in small quantities, first the lye, then the acid. Each batch of acid and lye amounts to a height of about 3 centims. in the tank. The alternate filling with lye and acid is continued until the apparatus is full, the stirrer being in motion meanwhile; then the mixture is heated to 60° C., stirred for a short time, and finally enough acid is added, that a sample distinctly shows the smell of sulphurous acid. For this purpose a small quantity of acid is generally sufficient.

The skilful workman can easily detect the point of complete precipitation by the colour and odour of a sample. The conditions having been fulfilled, the decomposed lye is drawn into the settling vats, one-third remaining in the tanks; the sulphurous acid contained in this part is intended to prevent the disengagement of sulphuretted hydrogen, when fresh lye is added. In the settling vats, the sulphur settles almost completely, and rapidly; while the lye of calcium chloride, after the filling of the first vat, runs into a second at a lower level, and from this into a third at the same level, in which two the sulphur settles completely. The solution of calcium chloride is run off, having no value. The sulphur is lifted from the settling vat into a funnel-shaped wagon, from which it falls directly into the well-known refining apparatus of Shaffner.

As regards the composition of the lyes respecting the compounds which they contain, the views of the chemists who have examined them differ materially. Especially is the case with regard to the higher sulphide of calcium, which is supposed to exist in the lyes, as well as to the reactions by which the compounds are formed in the waste during the oxidation or lixiviation. According to W. Hofmann, the calcium-monosulphuret supposed to exist in the waste is decomposed into calcium oxide and calcium disulphuret, the former being converted into calcium carbonate by the carbonic acid of the atmosphere, the latter into calcium hyposulphite by oxidation. By the elevation of temperature during the oxidation, the latter is immediately split into sulphur and calcium sulphite, which by further oxidation is transformed into calcium sulphate. The free sulphur converts another part of calcium disulphuret into higher polysulphurets, *i.e.* into CaS_3 and CaS_4.

C. Mène, who gave a description of Mond's method, supposes the oxidation to take place in such a manner that to 1 mol. calcium hyposulphite and 2 mols. calcium monosulphuret are formed; a hypothesis which is defended by Mond himself. According to Mond, at first calcium sulphhydrate and calcium disulphuret are formed, both of which are afterwards oxidised to calcium hyposulphite. Part of this is again decomposed to calcium sulphhydrate and calcium sulphite, which latter as an insoluble substance causes loss of sulphur. According to Mond, the resulting lye always contains calcium hyposulphite, calcium sulphhydrate and calcium polysulphuret of the formula CaS_2.

Mond was the first to put forth the interesting opinion, based on experiments, that by the decomposition of the lyes with muriatic acid, the calcium hyposulphite is not split into calcium sulphite and sulphur, $CaS_2O_3 = CaSO_3 + S$, but into calcium trithionate mixed with small quantities of calcium pentathionates.

$$5CaS_2O_3 + 6HCl = 3CaCl_2 + 3H_2O + 2CaS_3O_6 + 4S.$$

On being heated, the calcium trithionate is decomposed into calcium sulphate, sulphur, and sulphurous acid, the latter converting another part of calcium hyposulphite into calcium trithionate with the separation of sulphur, $2CaS_2O_3 + 3SO_2 = 2(CaS_3O_6) + S$. In the same manner the decomposition and formation of calcium trithionate go on, thus accounting for the presence of calcium sulphate in the precipitated sulphur. Schaffner opposes this assumption, and explains the formation of the calcium sulphate by the presence of sulphuric acid in the crude hydrochloric acid used for the decomposition. According to him, by the oxidation of the waste calcium hyposulphite and the polysulphurets CaS_2 and CaS_5 are formed.

Considering that the soda process is conducted in the same manner in all existing works, it is safe to presume, that with regard to the qualitative composition there are no differences, and that, further, likewise the oxidised waste and the resulting lyes must be analogous. The quantitative composition of the sulphur lyes, however, as has been proved by Richtors, can show great differences, *i.e.* the different compounds formed by the oxidising process can be present in the sulphur lyes in varying proportions. The cause of the difference in the composition of the lyes is the duration of the oxidation, the temperature, and perhaps the varying amount of moisture in the waste. It is generally conceded, that in the sulphur lye the compounds of sodium and calcium with hyposulphurous acid are present, and likewise the sulphhydrates of these two metals. The statements regarding the compounds of the two named metals with sulphurous acid are inaccurate; it is only mentioned, that the calcium sulphite is insoluble and causes loss of sulphur. The statements about the polysulphurets of the metals are entirely contradictory, it being assumed, in order to explain the process, that the lye contains, besides calcium sulphhydrate, calcium di-, tri-, tetra-, or penta-sulphuret. As far as I know, a sodium polysulphuret has never been mentioned, although it is highly probable, that, according to the preparation of the lye, such a one is formed.

With regard to the compound of calcium and sulphur, the excellent researches of Emil Schöne have not been taken into consideration, which show beyond doubt, that the old views about the calcium sulphurets are erroneous.

The experiments of Vauquelin, which were made as far back as 1817, prove that no calcium polysulphurets can be obtained by the dry process. Buchner, 1816, and Herschel, 1820, obtained in the wet way compounds of calcium and sulphur, which were considered as being composed of calcium oxide, sulphuretted hydrogen, and water. Later, in the year 1842, Heinrich Rose obtained, by a method differing from that of Buchner and Herschel, crystals, resembling in their appearance those prepared by the latter, and to which Rose assigned the formula $CaS_5.5CaO + 20H_2O$. The compound, therefore, contained the CaS_5 of Berzelius, which is formed by saturating CaS with sulphur in solution.

Schöne, who subjected this matter to an extensive examination, found that solutions of calcium polysulphurets on evaporation never separate pure polysulphurets in a cystalline form, or leave them afterwards in a solid and pure state; they are decomposed by water with the disengagement of sulphuretted hydrogen and the separation of a solid mass, consisting of calcium hydrate and sulphur. In order to ascertain which calcium polysulphurets can exist in solution, calcium monosulphuret, prepared from pure carbonate of lime, bisulphide of carbon, and carbonic acid at an elevated temperature, was boiled with different quantities of sulphur and water. The experiment proved, that calcium, with less than four molecules sulphur cannot exist in solution, and that if less than three molecules sulphur to one molecule CaS were brought in contact with water, only enough calcium sulphuret went into solution to form CaS_4, that the remainder of the CaS was indifferent toward the sulphur and was decomposed by the water in the manner indicated by Rose into calcium hydrate and calcium sulphhydrate, the former of which dissolving partly, the latter entirely, with the tetrasulphuret, Schöne has given the following formulæ for this highly interesting reaction:

1. $6S+6CaS+4H_2O=2CaS_4+2CaH_2S_2+2CaH_2O_2$.
2. $12S+6CaS+2H_2O=4CaS_4+CaH_2S_2+CaH_2O_2$.
3. $18S+6CaS=6CaS_4$.

In the experiments 1 and 2, the presence of the calcium sulphhydrate was proved by solution of manganese sulphate; in the solution 3 only traces of this compound were found. The CaS_4 formed in these experiments can dissolve another molecule S, if hot even more, and therefore corresponds completely with the sulphurets of barium and strontium. Like these latter compounds CaS_4 has the property, but in a higher degree, of crystallising together with lime and forming those compounds, which have been examined first by Herschel and Buchner, and later by H. Rose. Schöne obtained Herschel's compound by boiling pure caustic lime with sulphur and much water for an hour, filtering the hot solution and letting it stand with pure calcium hydrate. The crystals formed upon the latter after some days, had, after drying over sulphuric acid, the composition $3CaO,CaS_4+12H_2O$. According to Schöne, for the formation of this compound, the presence of lime and calcium hyposulphite is necessary; without the latter salt it does not form.

The crystals obtained by Rose, of the above formula, were formed from a solution of calcium sulphhydrate, if it was evaporated with free excess of air. Schöne obtained the crystals by treating a large quantity of milk of lime with sulphuretted hydrogen for several days and leaving the filtered lye closed not quite tight for 6 months. The lye, which had turned yellow, was then evaporated to half its bulk, when a large quantity of sulphuretted hydrogen was evolved, and calcium hydrate separated. After being left in a cool place for several weeks, numerous orange-yellow prismatic crystals had appeared, which had the composition $4CaO,CaS_4+18H_2O$. The compound, therefore, does not contain CaS_5, as Rose thought, but CaS_4 combined with CaO and H_2O; according to Schöne, it is probably always formed when CaS_4 meets CaH_2O_2 and CaH_2S_2.

These facts evidently show, that in the lyes from soda waste, no other polysulphuret but CaS_4 and CaS_5 can exist, as Schöne has proved by experiment that lower polysulphurets cannot exist in solution. The great affinity of CaS_4 for CaO and water, with which it forms crystallised compounds, must also in the sulphur lyes make itself felt, producing in the first place the compound $4CaO,CaS_4+18H_2O$, because it is mainly formed under the precautions observed in the preparation of the lyes, *i.e.* at an ordinary, or slightly elevated temperature. As I shall show later, the hyposulphurous acid as well as part of the sulphhydrate are present in the lye as sodium compounds, and therefore it is not impossible, that sometimes the compound $3CaO,CaS_4+12H_2O$ may be formed, provided it is correct, that for the formation of the two compounds the presence of calcium sulphhydrate respecting calcium hyposulphite is required. In this case, however, I should like to extend this view so far, that the formation of the two salts entirely depends on the presence of a sulphhydrate or a hyposulphite.

According to Schaffner, the amount of sodium in the waste corresponds to 4—5 per cent sodium sulphate; it is asserted, that by the oxidation it is almost completely dissolved, whence it follows, that in the examination of the lyes, the sodium compounds must be taken into account. I now come to the examination of the lye mentioned above; to which I was led by the formation of splendid orange-coloured, spear-like crystals, 3—5 inches long, which had formed in the lye after it had been standing for several months with the exclusion of air, and which analysis proved to be $4CaO,CaS_4+18H_2O$.

Separated from the lye, the crystals decomposed while still moist, turning lighter, and finally quite white. In contact with water after some time, or by being warmed with it, they were completely decomposed, calcium hydrate and sulphur being formed with the evolution of sulphuretted hydrogen.

A determination of the sulphur and calcium in the moist salt, in order to ascertain the relative quantities of the two elements, gave 15·7 per cent sulphur to 23·64 calcium, the formula $4CaO,CaS_4+18H_2O$, requires the proportion 15·13 sulphur to 23·64 calcium. The salt pressed between filtering paper, dried at 100° C., gave 35·21 per cent loss. According to Schöne, it loses, under these conditions, three-fourths of the total amount of water, and about one-half of the sulphuretted hydrogen, which it evolves with acids. The loss, therefore, would be 36·2 per cent, a figure which in this case corresponds sufficiently with the one found.

0·4955 grm. of the salt were oxidised with aqua regia, the non-oxidised sulphur was filtered, in the filtrate, the lime was first precipitated by ammonia and oxalate of ammonia, and then the sulphuric acid by barium chloride. 0·347 grm. $CaCO_3$ and 0·0842 grm. sulphur were obtained.

0·311 grm. were gently heated with oxide of copper and binoxide of lead in a current of air, as in an organic combustion, and yielded 0·138 grm. water.

	Found.	Average. According to Schœne.	Calculated.
Ca	28·01	28·47	27·93
S	17·00	16·99	17·88
H_2O	44·34	45·27	45·25

The crystals are much more stable in the dried than in the moist state, but even over sulphuric acid they continually give off sulphuretted hydrogen, and soon lose their lustre, assuming a darker colour. Crystals of this kind contained 29·49 per cent calcium and 19·68 per cent sulphur.

If the clear sulphur lye is mixed with absolute alcohol, almost instantly shining scales and needles of yellow colour are formed, which by standing for some hours grow to thin plates. They behave towards reagents like the large oxytetrasulphuret crystals, and have the same composition.

0·6367 grm. gave 0·109S and 0·176 Ca.
0·226 ,, ,, 0·100H_2O.

This corresponds to 17·10 per cent S, 27·6 per cent Ca, and 44·2 per cent H_2O.

For the determination of the sulphur in the crystals, Schöne made use of the chlorine analysis, decomposing the crystals in water by a current of chlorine and determining sulphur and calcium in the solution in the above manner. Thus he intended to avoid a loss of sulphur, caused by the evolution of sulphuretted hydrogen. My analyses show the determination of sulphur by means of aqua regia to be at least as accurate. Another method, which excludes all loss of sulphur, gives accurate results, and is well adapted for all similar sulphur compounds, is the following: The compound is mixed with very little water, powdered chloride of copper, and then with a little dilute hydrochloric or nitric acid, whereby the sulphur-

etted hydrogen, which would be set free, and a part of the remaining sulphur, are instantly converted into sulphide of copper. By adding strong nitric acid, and boiling, a clear copper solution is obtained, in which the sulphuric acid is determined. The non-oxidised sulphur is previously filtered and weighed. An analysis of the calcium oxytetrasulphuret, made in the manner described, gave 17·35 per cent sulphur.

If the calcium oxytetrasulphuret is decomposed by hydrochloric acid, sulphur separates and hydrogen trisulphide is formed, which has been detected in the decomposed lyes by A. W. Hofmann: this is the cause of the quantity of precipitated sulphur being less than it ought to be. By a direct determination 12 per cent S were found, while the formula for the three molecules S requires 13·4 per cent S.

On trying to concentrate the lye over sulphuric acid, it is decomposed, losing its colour, and separating sulphur. The liquid contains hyposulphites and sulphates.

By concentrating the yellow lye in a flask, boiling all the while, it is coloured yellowish brown. A considerable precipitate is formed, consisting chiefly of calcium sulphite mixed with calcium hydrate and sulphate. On cooling, the liquid assumes the original colour, and behaves exactly like the original lye. With alcohol the yellow scales and needles are formed; after protracted standing they separate in such quantity that the fluid resembles a paste. While the crystals formed from normal lye are stable in contact with it, the crystals in the concentrated lye are decomposed after standing for weeks, if the air is not completely excluded, the lye not losing its colour. If the lye, which has been mixed with alcohol, and thereby freed to a certain degree from oxytetrasulphuret, is again mixed with absolute alcohol until no more precipitate is formed, the latter is yellow in the beginning, but soon becomes quite white. It is insoluble in water, and easily purified by washing; it completely dissolves in hydrochloric acid with the evolution of sulphurous acid, and the analysis proves it to be, beyond doubt, calcium sulphite. It yielded dry 42·33 per cent lime, $CaSO_3+\frac{1}{2}$aq., requires 43·4 per cent lime. The last parts of the precipitate, especially if a large excess of alcohol had been added, contain calcium hyposulphite, which has been formed by decomposition from the sodium salt.

The precipitated sulphite does not re-dissolve, even if added to large quantities of fresh lye, after prolonged action. It is not impossible that this peculiarity may be explained by the fact that the calcium sulphite does not exist in the lye in the free state, but in combination with another sulphur compound, which is decomposed by a change of the solvent. The existence of such compounds of calcium sulphite has been proved by Kuhlmann, who observed the compound $CaSO_3+2CaS+6$aq., in the form of fine yellow crystals in old heaps of soda waste.

If the lye which has been precipitated with alcohol is left to stand in a closed flask for several months, not inconsiderable quantities of fine and well-formed crystals of sodium hyposulphite are formed. Other acids of sulphur, besides sulphurous, hyposulphurous, and sulphuric acids, were not present in the lye; at least, after treating the lye with carbonic acid until all sulphuretted hydrogen was driven off, none of Kessler's reactions for tetrathionic and pentathionic acids could be obtained. The reactions for trithionic acid, indicated by hyposulphurous acid, which behaves exactly like trithionic acid; this is proved by the fact, that after completely decomposing the lye with hydrochloric acid, only traces of sulphuric acid are found, which ought to have been present in larger quantities as the product of the decomposition of trithionic acid.

By passing carbonic acid through the sulphur lye, until no more decomposition takes place, and all sulphuretted hydrogen is driven off, then boiling for a short time, in order to precipitate the dissolved calcium carbonate, after filtering, a yellowish precipitate and a colourless filtrate are obtained. The former consists of pure calcium carbonate and sulphur; the latter contains little sodium carbonate and larger quantities of sodium hyposulphite, which on concentration crystallises entirely free from lime. By this operation the sodium sulphur compounds of the lye are converted into carbonate, which decomposes the calcium sulphite (which has been converted into hyposulphite), precipitating calcium carbonate. The excess of sodium carbonate remains in the lye.

If the same experiment is made with the lye, from which the excess of calcium salts has been removed by alcohol, a precipitate of pure calcium carbonate and sulphur is likewise formed; the filtrate has a yellow colour from dissolved sulphur, and turns olive-green when heated; mixed with water it becomes colourless with the separation of sulphur, and after evaporation it also yields crystals of sodium carbonate and hyposulphite, which are free from lime. Analysis, however, showed the quantity of sodium carbonate to be much more considerable, for the calcium sulphite has been precipitated by the alcohol, and therefore is not, as in the former case, decomposed by the sodium carbonate, whose quantity is correspondingly larger.

Bisulphide of carbon extracted from the lye a consider-quantity of sulphur, a proof that the lye contained free sulphur in solution, *i.e.* dissolved by the calcium polysulphurets. The lye can dissolve still more sulphur, as is shown by the sulphur, which has been precipitated by a few drops of acid, being re-dissolved by agitating.

By adding solution of protoxide of maganese to the lye, sulphuretted hydrogen was evolved, a proof of the presence of sulphhydrates—here sodium and calcium sulphhydrate. Further analytical experiments justify the assumption, that besides those compounds, whose presence has been directly proved, calcium pentasulphide is contained in the lye. Therefore the lye contains:

$$CaS_5 ; 4CaO,CaS_4+18aq ; CaSO_4 ; CaSO_3 ; Na_2S_2O_3 ; NaHS ; CaH_2S_2 ; S.$$

In order to ascertain the relative quantities of the different compounds, the following determinations, to be described hereafter, were made:—Sulphurous, hyposulphurous, and sulphuric acids, and the sulphuretted hydrogen of the sulphhydrate, all the sodium and calcium, the total amount of sulphur, and finally the sulphur and calcium, which were precipitated by carbonic acid, were determined. From the numerical results the compounds could be established and calculated.

(To be continued.)

PYROLOGY, OR FIRE ANALYSIS.*

By Captain W. A. ROSS, R.A.

1. PYROLOGY, as distinguished from ordinary blowpipe manipulation, may be described as the art of inducing chemical changes in substances from which their *composition*† can be concluded, by the scientific application to them of fire, and the use of *acid* as well as alkaline fluxes for purposes of solution and of separation.

2. The term "pyrocone" is used instead of that of "flame," employed by writers on the blowpipe, which last expression is here only applied to flames without a definite shape (*vide* paragraph 25), both because such a distinction is evidently a more correct phraseology, and because it prevents otherwise unavoidable confusion when both kinds of fire are produced in the same operation. For similar reasons the word "blowpipe," which seems a coarse and inexpressive appellation, equally applicable to a pea-shooter and the tubes of an organ, will be relinquished in these pages for the term "pyrogene."

Pyrocones.

3. Pyrocones are divided into two classes, (*a*) natural and (*b*) artificial; *a* is the shape candle and other flames

* Communicated by the Author. From the *Proceedings of Royal Society.*

† In the term *composition* is included the quantitative as well qualitative estimation.

assume in air when left to themselves; *b* is that formed by treating *a* artificially as follows:—

4. On the application of a fine jet of air or breath, such as is impelled by operators with the pyrogene, to one side of the base of the natural pyrocone, the unburned gases in the centre are apparently expelled; the luminous cone, unless the blast is too weak, entirely vanishes, and what now appears is a long *solid* tongue of blue light, terminating in a point of needle-like fineness with a violet-

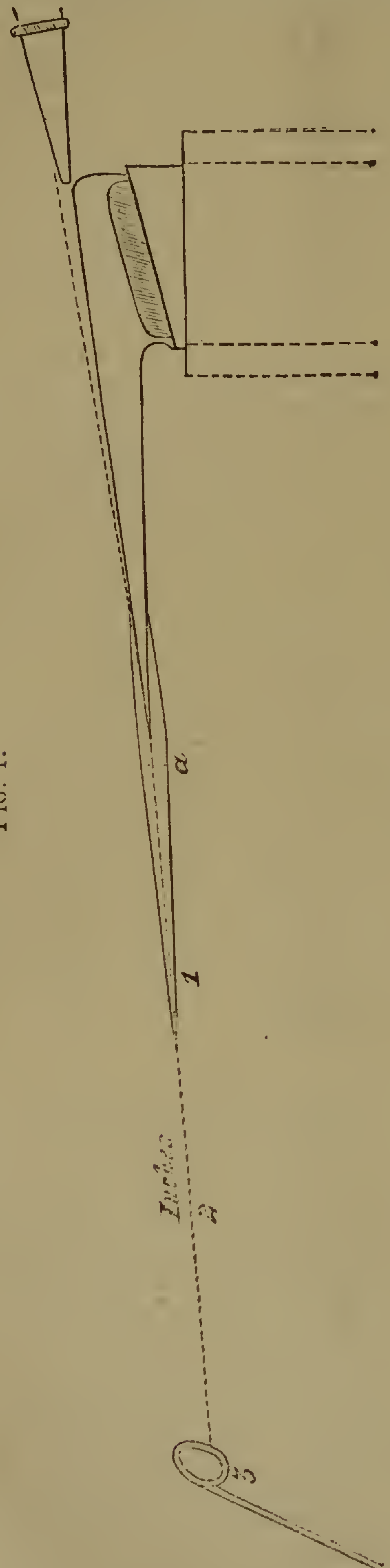


Fig. 1.

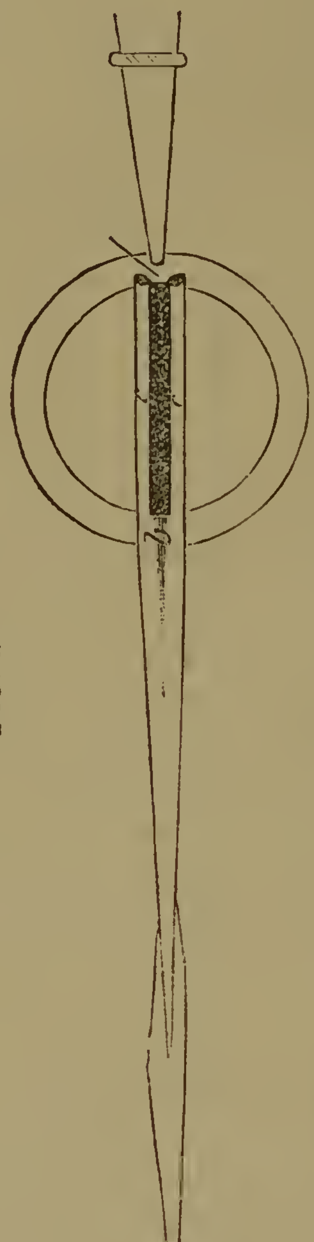


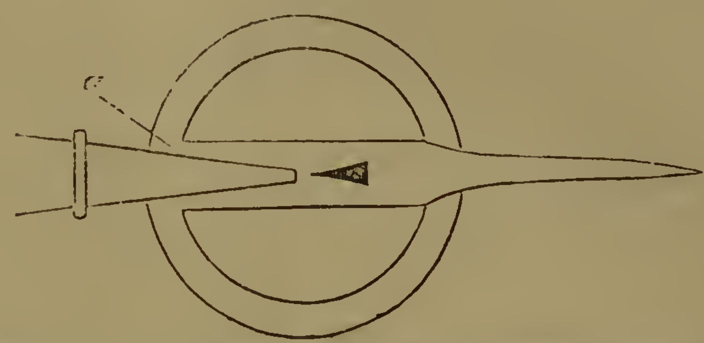
Fig. 2.

coloured cone enveloping the apex, and extending, with a more obtuse termination beyond it, to a distance commensurate with the strength of the blast.

5. If we take the natural pyrocone afforded by ignited spirits or other light hydrocarbon producer, and blow into the centre of it with a mouth pyrogene, the jet of which is kept at some distance from one side of the cone, we observe two *synaxial* pyrocones formed by the blast, the bases of which are contracted or enlarged proportionately with its strength or weakness. If we approach the jet of the pyrogene so as to touch the side of the spirit-lamp pyrocone, and blow with greater violence, the inner or blast cone becomes invisible from the accelerated movement of the air; but we must analogically conclude that its basic diameter is contracted, and its length extended proportionately with those changes in the outer or *visible* pyrocone.

6. That the air or breath from the pyrogene is driven *through* the longitudinal axis of the artificial spirit-pyrocone is also easily proved by the operator blowing with

Fig. 3.



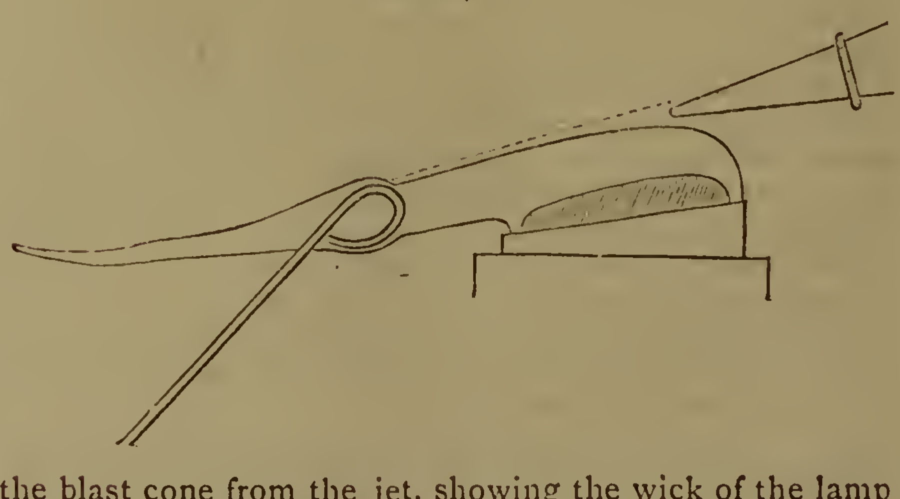
still greater violence, when the apex of the cone will be observed to be broken up by the blast at the under extremity, the sides remaining intact, so that the form is now that of a hollow cylinder.

7. Very different is the pyrocone produced by the attempt to blow into the natural one afforded by the flame of ignited oil,* wax, coal-gas (not previously mixed with air as in the Bunsen burner), or other dense hydrocarbon. The blast cone no longer penetrates the blue flame, but moves *above* it, drawing out, as it were telescopically, a *solid* pyrocone from under its base, so that the two cones are no longer synaxial, but conjunctive (Fig. 1).

8. If we view this pyrocone from above, the diagram (Fig. 2) is something like what we see. All ascending heat from the lamp is completely stopped; whereas we could not view the spirit-pyrocone from a like position without burning the face, because in the first case the natural pyrocone is bent, as it were, under the blast, but in the second merely bored through by it.

9. It will be seen from Fig. 2 that the hollow nucleus of the natural pyrocone, which we have assumed to be filled with unburned gases, is traversed over its whole length by

Fig. 4.



the blast cone from the jet, showing the wick of the lamp underneath as a black band, the breadth of which is directly proportional to the diameter of the base of the blast cone, and therefore inversely so to the strength of the blast, which, blowing in the short side, *a*, of the blue or hydrocarbonous perimeter, *into* its long sides, *c c*, causes these latter to rise slightly like flame-walls on either side, and draws them along with it until they combine at *b* to form a solid pyrocone underneath it, as above described.

10. If the short side, *a*, be burst by the insertion of the jet, instead of by the blast, the shape of the latter, as seen from above over the wick, is that represented in Fig. 3, the

* Cocoa-nut oil (if it be perfectly pure) affords by far the best pyrocone, and coal-gas almost the worst, for the purposes detailed in paragraph 15.

size and power of the resulting pyrocone being immensely diminished.

11. If, therefore, the blast in pyrological operations were driven *through* the long axis of the oil- or gas-lamp artificial pyrocone, as is generally assumed, and as is undoubtedly the case with the *spirit*-cone, we could not (1) see the lamp-wick as through a *transparent* medium like air, and (2) the heat ascending from the upper part of the pyrocone would be felt upon the face of the operator stooping over it; but it must be here observed that, to produce these effects, the volume and strength of the blast must bear a certain proportion to the size of the natural pyrocone.

12. It would be reasonable to expect from the above that the spirit- and oil-lamp pyrocones should possess different properties, and this is the fact. The pyrogenical or artificial cone of the former cannot, or can but feebly, attain the results produced by the latter. Filled with breath-vapour, instead of being solid, it has too much heating-power, while the enclosed gases interfere both with the oxidation and the reduction of the subject of analysis.

13. It follows, also, from a consideration of Fig. 2, and the facts detailed in par. 9, that the central portion of the wick or fuel in ordinary pyrological lamps is unutilised; and in fact if an oil-lamp be used having two thin wicks instead of one thick one, and these be slightly pressed apart in the front (as at *a*, Fig. 2), it will be found that a pyrocone of nearly double power will be produced by a similar blast and expenditure of fuel.*

14. Keeping the assumed fact of the superincumbency of a blast cone, and the consequent solidity of the blue pyrocone underneath, in remembrance, we can readily understand that a roundish object placed in the latter about the centre of its longitudinal axis, which has a diameter equal to or less than that of the pyrocone, will be wholly enveloped by the ignited gas or gases of which the cone is composed, so as to form a kind of bulb or jacket round the front, *i. e.*, that side towards the base of the pyrocone whence the current proceeds. The object is thus apparently preserved from communication, not only with atmospheric oxygen, but with unignited gas of any kind. Such an envelopment is termed—

The Hydrocarbonous Pyrocone (Symbol H. P.) (Fig. 4).

15. The behaviour of different substances when held steadily in the hydrocarbonous pyrocone causes it to be a synthetical and analytical agent of great value to the pyrologist. Substances of a viscid nature (not salts), as phosphoric or boric acid, become coated, after a few minutes' insertion, with a shining lustrous film having an extraordinary resemblance to a metal,† which, when gold or silver oxides are previously dissolved in the former bead, becomes tinged with yellow in the first case, and with a silvery shade in the second, much as alloys of those metals would. This film evidently increases in thickness according to the length of time it is immersed in the hydrocarbonous pyrocone, for after a short immersion the glass is still semitransparent; but when held a longer time it becomes opaque.

16. The film thus formed is very hard, being unsusceptible to the point of a penknife. It has no taste, or, if any, that of a metal, while the taste of the oxidised phosphoric acid is sharp and acidulous. After the application of the tongue, an iridescent tarnish is left like that of sulphur upon silver; in fact none of these films will stand long exposure to a damp atmosphere. They are so very thin and hard that it seems impossible to remove any portion from the glass (which remains vitreous in the inside) with the forceps, or even by breaking up the whole bead.

17. Sulphur, in the viscid or red and resinous state, is also changed by this treatment to a metallic appearance on its outer surface; but to produce this reaction the pyrocone must be very perfect and of an unmodified blue colour, or the sulphur will be at once ignited and burn away. When once prepared in this way sulphur has no further tendency to burn, and it then has the remarkable property of giving, in a glass of phosphoric acid, reactions similar to those of copper, viz., green hot, and blue-green cold after treatment with a peroxidating pyrocone (to be hereafter described); but green hot and cold after a reducing pyrocone has been applied.* Ultramarine might owe its blue colour to this fact.

18. When a roundish mass of silica or alumina, or of both combined, is held in the hydrocarbonous pyrocone, it becomes quite black; and as this blackness is not merely on the surface, but throughout the mass, it would appear to be due to a decomposing effect exerted by the latter upon the pyrocone itself, and not a mere deposition of soot, which might have been supposed to have been mechanically carried along by the blast upon its surface. Alumina, however, appears to become partially fused, and thus forms into roundish or botryoidal swellings, while silica presents a steel-black mass to the lens with shining metallic-looking points in it. These two omnipresent and almost universally combined earths, therefore, may be thus pretty correctly and extremely rapidly distinguished.†

Alkaline Earths in H. P.

19. Lime, strontia, and, to some extent, baryta and magnesia, are not thus carbonised by treatment with the hydrocarbonous pyrocone, and may therefore, when pure, be easily thus distinguished from the two first-mentioned earths. For lime, especially, a quantitative assay may be approximately made by slaking the mass thus treated in distilled water, when it will remain dark or grey or white, according as the lime exists in lesser or greater proportion. Above 80 per cent of lime will cause the mass to remain perfectly white. The oxide of iron does not interfere with this reaction.

20. This property, which lime possesses, of remaining perfectly white and of resisting all tendency to reduction during such treatment, renders it an excellent medium for the detection of chlorides and fluorides, which seem to separate after a time from the lime, and to form some combination with the carbon of the pyrocone, the lime having no such tendency; for instance, in chloride of calcium, after a few minutes of this treatment, a small black patch, round in proportion to the sphericity of the mass, is formed on the side next the current of blue flame, which can be easily seen through the lens to be not soot, and seems to have a sweet taste; but if such a mass be often quenched in distilled water, and as often re-treated in the hydrocarbonous pyrocone, the black patch will shortly assume a metallic and white appearance.

21. Fluorides after the above treatment exhibit an irregularly-shaped patch, also next the direction of the hydrocarbonous current; but this patch, instead of being black, has a changeable green colour, like some of the aniline compounds, and, after some quenching with water, a metallic appearance, but still green.

22. A very curious result is obtained by the treatment of bicarbonate of soda in the hydrocarbonous pyrocone. After a short time violent ebullition commences in the melted bead; bubbles of some (carbonic acid?) gas are seen to rise with great rapidity through it while red-hot. In this state of violent ebullition fragments are projected from the mass, which, when examined through a lens, are found to be black hollow spheres like microscopic shells. Notwithstanding the loss occasioned by the ejectment of these projectiles, the mass, if now carefully examined by a lens, will be found to consist partly of caustic soda, and partly of a black substance, solid, and even angular and shining like a piece of coal. This substance is proved to be carbon by its deflagration when heated with nitre, and its formation is proved to be not due to a deposition of

* Messrs. Price and Co. have manufactured, to the order of the writer, pyrological candles with a double wick on this principle.

† These films are difficult to produce with coal-gas, on account of its general impurity. *Vide* par. 4.

* These effects are only in part producible by a gas-pyrocone. *Vide* pars. 4 and 7.

† The writer, by compressing the tip of the platinum jet, so as to form a slit there, instead of a round orifice, produced a very perfect H. P.

soot from the lamp-flame, by the fact that the similar treatment of chloride of sodium will produce no such result.

23. If any of the "earths" be held on platinum-wire after being made into a paste with a little distilled water in a hydrocarbonous pyrocone, those which carbonise in such a situation, as alumina and silica, being slightly heated in an oxidating pyrocone for a few seconds so as to just burn off the carbon, and if the mass be then saturated with cobalt solution, lime and strontia will immediately turn a distinct blue; and of these two, if allowed to remain exposed to the air for a time, the lime will slowly turn green, the strontia brown.* The previous addition or existence of iron sesquioxide will cause these to turn, instead of blue, green in the first instance. All the other earths, if pure and not in a chemically caustic state, become pink with cobalt solution; and if then they are approached carefully to the natural pyrocone of a spirit-lamp, this pink colour deepens to a rich carmine.† Of these earths, alumina and magnesia will (as is known), when treated with a peroxidising pyrocone, change, the first to a deep blue, the second to a pale flesh or salmon-colour. Silica in this case turns a distinct purple, even in presence of oxide of iron; lime, baryta, and strontia, a grey or grey-black. We thus obtain a nearly new chromatic series between the common "earths" of considerable value in analysis, as follows:—Lime (a) and strontia (b) *blue*, changing on exposure to air (a) to green and (b) to brown. Alumina (a'), silica (b'), baryta (c'(, and magnesia (d'), *pink*, changing on treatment with a peroxidising pyrocone (a') to blue, (b') to purple, (c') to grey-black, and (d') remaining pink.

24. Berzelius, and after him Plattner and other writers on blowpipe analysis, tell us we "are not to take notice of any changes of colour in a substance to which cobalt solution has been applied *previous* to the further application to it of an oxidating flame; for the colour imparted, blue, red, or black, proceeds from the cobalt solution only, and not from any of the ingredients;" from which statement it is evident that we have hitherto lost some of the most valuable qualitative indications of cobalt, due to the important fact that lime and strontia are rendered caustic by much less heat than the other "earths," and therefore dehydrate the cobalt solution after treatment with a hydrocarbonous pyrocone, rendering it blue, which none of the other earths will do. If the colours "proceed from the cobalt solution only," how is it that lime turns *blue* and baryta *red* when it is thus applied?

(To be continued.)

* Fluoride of calcium *remains* blue.

† Oxide of *zinc* thus treated affords a beautiful peach-colour; oxide of *tin*, after P. P., a green.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 27, 1873.

This number contains the following original papers relating to chemistry:—

Preservation of Alimentary Substances by the Application of Great Cold.—Professor Boussingault.—The author states that a quantity of beef-tea having been submitted some eight years ago to a temperature of −20° for several hours, has remained in perfectly good condition up to the present time. Sugar-cane juice was at the same time subjected to this treatment, and was found to be in excellent condition. Both substances had of course been kept in closed vessels.

Determination of the Boiling-Point of Liquefied Sulphurous Acid Gas.—I. Pierre.—While referring to some experiments made by Professor Melsens, the author states that twenty-six years ago he gave a detailed account (see *Ann. de Chimie et de Phys.*, 3rd series, vol. xxi.) of a process by means of which the boiling-point of the liquefied gas may be readily ascertained.

Researches on the Allotropic Transformations of Phosphorus.—L. Troost and P. Hautefeuille.—This exhaustive monograph treats on the relation existing between the temperature and pressure as bearing upon the conversion of ordinary phosphorus into its allotropic modification.

Application of the Monochromatic Light Produced by the Sodium Salts for Ascertaining the Change of Colour of Tincture of Litmus in Alkalimetrical Assays.—L. D'Henry.—The description of a Bunsen gas-burner so arranged that the flame is kept constantly saturated with sodium, so that while the blue colour of litmus appears deep black, the red colour, produced by the addition of an acid, appears as colourless as water; thus affording a better means of ascertaining the precise moment when the alkali is saturated.

New Tertiary Alcohol, and on a Method of Preparing a Series of Tertiary Alcohols.—C. Friedel and R. D. Silva.—This essay, elucidated by a series of complex formulæ, treats on pinacone, pinacoline, and on the combinations thereof among these dimethyl-isopropyl-carbinols.

Commercial Assay of Nitrates.—H. Joulie.—Reserved for translation.

Spontaneous Alteration of Eggs.—U. Gayou.—The author comes to the conclusion that the main cause of the decomposition of eggs is the presence of small organisms which must have formed in the egg while in the oviducts of the fowl.

Analysis of Arite from the Ar Mountain (Basses Pyrénées).—F. Pisani.—The mineral just named is amorphous, sp. gr. 7·19; composition in 100 parts—Sulphur, 1·7; arsenic, 11·5; antimony, 48·6; nickel, 37·3; zinc, 2·4; total, 101·5. Formula, $Ni_2(Sb,As)$.

Polytechnisches Journal von Dr. E. M. Dingler, first number for January, 1873.

On the Technical Mode of Estimation of the Quantity of Oxygen Present in Gaseous Mixtures, and Description of two Newly-Devised Apparatus for the Purpose of Analysis of Gases.—Max. Liebig.—This essay, illustrated with engravings, treats on a method more particularly adapted for the qualitative and quantitative determination of oxygen present in the gases which leave the vent of sulphuric acid chambers. A detailed description of apparatus suitable for this purpose and for gas analysis generally is also given.

New Method of Assaying Lead Ores.—A. Mascazzini.—Previous to reducing the galena or other lead ore to the metallic state, the author converts the lead present in the ore into sulphate, by igniting it in a porcelain crucible with sulphate of ammonia, after which the ore is treated in the usual manner. The flux preferred by the author is that recommended by Plattner, consisting of—13 parts of carbonate of potassa; 10 of dry carbonate of soda; 5 of previously fused borax; and five of well-dried starch.

Process of Recovering in the shape of Alum the Potassa used in the Calico Printing Dyes and Pigments.—Cylinder Printing.—E. Schlumberger.

Preparation of Chlorates by the Aid of Chlorate of Alumina.—J. von Brandt.—The contents of this paper bear more strictly upon the preparation of aniline black. The chlorates of ammonia, alumina, and lime are obtained by a circuitous process with the aid of chlorate of potassa.

So-Called Chemical Carbon as used in Calico Printing Works.—E. Kopp.—This material is obtained by treating lamp-black with concentrated sulphuric acid, and afterwards thoroughly washing it with water. The finely-divided and dried material is used as a pigment, and found to contain, after having been dried at 120° (loss thereby 4·96 per cent moisture), in 100 parts:—Carbon, 80·25; hydrogen, 1·75; oxygen, 14·12; ash, 3·88. This substance is readily acted upon at 100° by ordinary nitric acid, and in the cold by strongly fuming nitric acid. The result of this reaction is the formation of an amorphous, deep yellow-coloured, and stringent matter.

Gazzetta Chimica Italiana, Nos. 8 and 9 (double number), 1872.

The Purple Pigment of the Ancients, and the Colouring-Matter found on the Vase of St. Ambrosius at Milan.—A. Bizis.—This exhaustive historico-chemical essay is devoted to the record of a series of experiments on indigo and other pigments for the purpose of comparing the reactions they exhibit with those of the purple of the ancients, as described in a work published under the following title.—"Dissertatione Sopra la Porpora Antica, e Sopra la Scoperta Della Porpora nei Murici, Venetia, 1843. The author of this essay thinks that the pigment found on the vessel alluded to is derived from the purple, which he states was still preserved and used for dyeing purposes at the time of Charlemagne, ninth century.

On Two Nitrophenol-Sulphuric Acids.—W. Koerner.—This monograph is divided into the following sections:—Indentity of Kolbe's and Gauhe's nitrophenol-sulphuric acid with Kekulé's; orthonitrophenol-sulphuric acid; salts of that acid.

On Iodo-Benzol Para-Sulphuric Acid.—W. Koerner.—After referring to the researches of Wurtz, Kekulé, Vogt, Oppenheim, and

others, the author describes at length the mode of preparation of iodo-benzol para-sulphuric acid, a very deliquescent body which forms crystalline compounds with potassa and baryta, and a white pulverulent, silky, shining combination with lead. By fusion with caustic potassa iodo-benzol para-sulphuric acid yields resorcin.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 1, 1873.

This number contains the following original memoirs:—

Basicity (Basicität) and Constitution of Superiodic Acid.—J. Thomsen.—A thermo-chemical essay elucidated by a series of diagrams and tables.

Preparation of Sulphuryl-Chloride, SO_2Cl_2, from Sulphuric Anhydride and Chloride of Boron.—G. Gustavson.—In the introduction to this paper the author gives a brief *resumé* of the labours of Schützenberger, Michaelis, Odling, Williamson, and others on the action of sulphuric anhydride upon the chlorides of the metalloids. The best proportions for the preparation of sulphuryl-chloride by the reaction of sulphuric anhydride upon chloride of boron is 1 equivalent of the latter to 2 of the former, to be heated together in a sealed tube to 120° for about eight hours; the result is the formation of sulphuryl-chloride, a fluid boiling at between 70° and 71°, decomposed by addition of water, yielding sulphuric and hydrochloric acids, and consisting, in 100 parts, of 52·59 of chlorine and 23·70 of sulphur. The reaction is exhibited by the following formula:—

$$2BCl_3+4SO_3=3SO_2Cl_2+B_2O_3.SO_3.$$

The last-mentioned compound, viz., a combination of boric acid with sulphuric anhydride, is a solid material, which, when thrown into water, gives rise to a violent reaction, resulting in the formation of crystalline boracic acid and dilute sulphuric acid. Sulphuryl-bromide cannot be obtained from bromide of boron and sulphuric anhydride by a similar process; but when silicium chloride and sulphuric anhydride are submitted to the same process, there is formed $S_2O_5Cl_2$.

Dissociation of the Oxide of Mercury.—J. Myers.—Reserved for translation.

Some of the Nitrogen Compounds of Anthrachinon.—R. Bœttger and T. Petersen.—This essay treats on the nitration of anthrachinon, and on α-mono-nitro-anthrachinon, $C_{14}H_7(NO_2)O_2$, a solid yellow-coloured substance, crystalline when sublimed, fuses at 230°, insoluble in water, barely soluble in ether, difficultly so in alcohol, but readily soluble in acetic ether, benzol, chloroform, oil of turpentine, glacial acetic acid, concentrated sulphuric acid and aniline, with which it combines; and this compound dissolves in acetic acid and ethereal solvents, exhibiting a most brilliant magenta colour. α-mono-nitro-anthrachinon is readily converted into the α-dinitro-anthrachinon by the action of nitrosulphuric acids, while, when the first-named substance is fused with caustic alkali, a large quantity of alizarine is formed. α-monamido-anthrachinon, $C_{14}H_7(NH_2)O_2$, a brick-red coloured powder, crystalline by sublimation, fusion-point 256°, difficulty soluble in alcohol and ether, but more readily so in chloroform, acetic ether, benzol, glacial acetic acid, and in concentrated sulphuric acid. α-diazo-anthrachinon, $C_{14}H_7N_2O_2.NO_3$, is a crystalline compound, soluble in water, which, by being heated with water, gives off nitrogen. The last portion of this essay treats at length on the behaviour of α-mono-nitro-anthrachinon with concentrated sulphuric acid. In an appendix, the authors state that anthrachinon or mono-nitro-anthrachinon can be directly nitrated, forming α-dinitro-anthrachinon by boiling with the so-called *acidum nitroso-nitricum* (sp. gr., 1·52). Nitric acid of 1·44 sp. gr. does not attack even dissolved anthrachinon at boiling heat. The mode of preparation of the compounds described is given in detail.

Red Colouration of White-Lead.—J. Lorscheid.—The author first refers to the paper on this subject by Bannow and Kraemer (see CHEMICAL NEWS, vol. xxvi., p. 35), and then states that about seven years ago he investigated this subject, having a large quantity of the red-coloured material to operate upon. In the main, the researches of the author and the other scientific chemists agree that the colour is not due to foreign metals, but to oxygen compounds of lead, including peroxide, but excluding the carbonate. The cause of the origin of the red colour is due to a deficiency of carbonic acid, and this is elucidated by the communication of some practical details relating to the making of white-lead.

Some of the Derivatives of Aceton.—A. Emmerling.—This essay treats on mono-bromaceton, the monoxy-derivative thereof, and on the relation existing between the carbohydrates and the oxy-derivatives of aceton.

Preparation of Fuchsine.—A. Brüning.—Fuchsine is industrially prepared by the author without the aid of arsenic acid, the reaction of nitrobenzol upon aniline being substituted for the acid. The fuchsine so prepared is in every respect like that prepared with arsenic acid, and can be produced equally cheap.

Sulphuretted (Geschwefelte) Tannic Acid from Phloroglucine.—H. Schiff.—The first portion of this essay treats on the action of pure disulphurylic acid upon anhydrous phloro-glucine, the result being the formation of a crystalline sulpho-acid which forms, with alkalies and the alkaline earths, soluble salts. The sulpho-phloroglucinic acid is isomeric with sulpho-gallolic acid (*sulfogallol saure*). Oxychloride of phosphorus acts upon the former in the same manner as on the latter. The second part of this paper, elucidated by a series of formulæ, records at length the rather complex mode of preparation of sulpho-tannic acid from the other compounds mentioned above.

Experimental Trials made for the purpose of Preparing Methyl-Ethyl-Acetic Acid, and Synthetical Preparation of a Suberic Acid-Ethyl-Ester (Kork-saure-ëthyl-ester).—C. Hell.—This monograph is divided into the following sections:—Monobrom-butyric acid-ethyl-ester; iodo-butyric acid-ethyl-ester; suberic acid-ethyl-ester.

On Pentachlorbenzols.—H. Ladenburg.—This paper records the determination of the boiling-points of some samples of pentachlorbenzol made by different chemists, and found in collections of chemical preparations, the aim being to try whether there exists more than one pentachlorbenzol, as stated by Jungfleisch. The boiling-points of these samples varied from 210° to 225°. In the concluding portion of this paper, the author corrects errors made by Jungfleisch in his paper published in the *Bull. de la Soc. Chim. de Paris*, concerning his (Ladenburg's) researches on pentachlorbenzol.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, February, 1873.

In addition to several memoirs bearing upon practical mechanics, this number contains the following papers relating to chemistry and collateral subjects:—

Mushet Steel.—J. Gruner.—A detailed account of the author's researches on the steel produced at Coleford (Gloucestershire) by the Titanic Forest Steel Works. In the hard metal, the author found—Silicium, 0·005; titanium, 0·002; carbon, 0·030. In the malleable metal—Silicium, 0·005; titanium, less than 0·002; carbon, 0·015. Another sample of Mushet's steel was found to contain no titanium, but as much as 8 per cent of tungstenum.

Normal Composition of Glass; Analysis of a Memoir by E. Banrath.*—H. de Fontenoy.—An exhaustive monograph, elucidated by a large number of tables exhibiting the detailed results of analyses of glass made by different authors during a period of sixty years, with quotations of the periodicals in which these results are published.

Although not relating to chemistry, we notice, from the proceedings of the meetings of this Society, a communication on—

Goïtres.—P. Thomas.—According to some practical proofs, the author believes that goïtres is due to the absolute absence of iodine from natural waters used in mountainous countries. These researches certainly deserve attention, for it appears that water coming in contact with cupreous pyrites, or the products of its oxidation, becomes absolutely free from iodine and its compounds.

The American Journal of Science and Arts, January, 1873.

The only original memoir relating to chemistry and published in this number is the continuation of a monograph on—

Researches in Actino-Chemistry.—J. W. Draper.

Les Mondes, January 30, 1873.

This number contains no original matter relating to chemistry, but we call attention to the following essay:—

Theory of the Formation of the Earth's Surface, Sketched in its main Characteristic Features.—J. Le Conte.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, September and October (double number), 1872.

This number contains no papers relating to chemistry.

Bulletin de la l'Academie Imperiale des Sciences de St. Petersbourg, vol. xviii., No. 2, November, 1872.

This number does not contain any original paper relating to chemistry.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 10th.—Medical, 8.
—— Geographical, 8½.
—— London Institution, 4.
TUESDAY, 11th.—Civil Engineers, 8.
—— Photographic, 8. (Anniversary.)
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 12th.—Society of Arts, 8.
—— London Institution, 1.
THURSDAY, 13th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
FRIDAY, 14th.—Astronomical, 3. (Anniversary.)
—— Royal Institution, 8.
—— Quekett Club, 8.
—— Royal Institution, 9. Mr. R. H. Scott, "On the Progress in Weather Knowledge."
SATURDAY, 15th.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

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* "Die Normal Zusammensetzung Bleifreien Glases und die Abweichungen von der Selben in die Praxis." Von Benrath. Aachen (1868): Druck von Georgi.

TO CORRESPONDENTS.

H. Hargreaves.—You cannot obtain single copies. Apply to Baillière and Co., 20, King William Street, W.C.

E. Wd., T. Holliday, R. Watson, and others.—We will try to ascertain.

Iodine.—Write to the Registrar at 17, Bloomsbury Square, W.C.

A. H. Allen, T. Wardle, J. Roberts, and W. Briggs are thanked for their communications. We will send them more particulars shortly.

and how used in dyeing? also, how is Blackley red made?—P. Burrows.

THE CHEMICAL NEWS.

Vol. XXVII. No. 690.

RESEARCHES IN SPECTRUM ANALYSIS IN CONNECTION WITH THE SPECTRUM OF THE SUN.—No. I*

By J. NORMAN LOCKYER, F.R.S.

The author, after referring to the researches in which he has been engaged since January, 1869, in conjunction with Dr. Frankland, refers to the evidence obtained by them as to the thickening and thinning of spectral lines by variations of pressure, and to the disappearance of certain lines when the method employed by them since 1869 is used. This method consists in throwing an image of the light-source to be examined on to the slit of the spectroscope.

It is pointed out that the phenomena observed are of the same nature as those already described by Stokes, W. A. Miller, Robinson, and Thalen, but that the application of this method enables them to be better studied, the metallic spectra being clearly separated from that of the gaseous medium through which the spark passes. Photographs of the spark, taken in air between zinc and cadmium and zinc and tin, accompany the paper, showing that when spectra of the vapours given off by electrodes are studied in this manner, the vapours close to the electrode give lines which disappear from the spectrum of the vapour at a greater distance from the electrode, so that there appear to be long and short lines in the spectrum.

The following elements have been mapped on this method;—Na, Li, Mg, Al, Mn, Co, Ni, Zn, Sr, Cd, Sn, Sb, Ba, and Pb, the lines being laid down from Thalen's maps, and the various characters and lengths of the lines shown.

In some cases the spectra of the metals, enclosed in tubes and subjected to a continually decreasing pressure, have been observed. In all these experiments the lines gradually disappear as the pressure is reduced, the *shortest lines disappearing first, and the longest lines remaining longest visible.*

Since it appeared that the purest and densest vapour alone gave the greatest number of lines, it became of interest to examine the spectra of compounds consisting of a metal combined with a non-metallic element. Experiments with chlorides are recorded. It was found in all cases that the difference between the spectrum of the chloride and the spectrum of the metal was that under the same spark-conditions all the short lines were obliterated. Changing the spark-conditions, the final result was that only the very longest lines in the spectrum of the metallic vapour remained. It was observed that in the case of elements with low atomic weights, combined with one equivalent of chlorine, the numbers of lines which remain in the chloride is large, 60 per cent., *e.g*, in the case of Li, and 40 per cent in the case of Na; while in the case of elements with greater atomic weights, combined with two equivalents of chlorine, a much smaller number of lines remain—8 per cent in the case of barium, and 3 per cent in the case of Pb.

The application of these observations to the solar spectrum, to elucidate which they were undertaken, is then given.

It is well known that all the known lines of the metallic elements on the solar atmosphere are not reversed. Mr. Lockyer states what Kirchhoff and Angström have written on this subject, and what substances, accord ing to each, exist in the solar atmosphere. He next announces the discovery that, with no exception whatever, *the lines which are reversed, are the longest lines.* With this additional key he does not hesitate to add, on the strength of a small number of lines reversed, zinc and aluminium (and possibly strontium) to the last list of solar elements given by Thalen, who rejected zinc from Kirchhoff's list, and agreed with him in rejecting aluminium. It need scarcely be added that these lines are in each case the longest lines in the spectrum of the metal.

The help which these determinations afford to the study of the various cyclical changes in the solar spectra is then referred to.

* Abstract of a paper read before the Royal Society.

DR. MORFIT'S WORK ON MINERAL PHOSPHATES.

By E. ESILMAN.

There is no doubt that whoever can rid mineral phosphates of the alumina and oxides of iron they contain, utilising the phosphoric acid with which they are combined, will master a problem the solution of which is daily becoming more and more desirable. Phosphates of iron and alumina are not admitted to be equal in manurial efficacy to phosphate of lime, and when made soluble in a manure render it liable to become damp. Many attempts have been made to overcome this objection to the use of many native phosphates, the latest of which is that of Dr. Campbell Morfit, described in his work entitled "Mineral Phosphates and Pure Fertilisers." On referring to this book, I found his method to consist in the fractional precipitation of hydrochloric acid solutions of impure phosphates by means of lime, or precipitated ferric or aluminic oxides or phosphates, so manipulating as to obtain a precipitate of dicalcic phosphate, almost pure, and a mother-liquor containing chloride of calcium, and phosphates of alumina and iron dissolved in hydrochloric acid. Not being able to find analyses of these products in the work referred it, I was induced to carry out the process on the small scale, so as to judge of its merits, but found myself unable to prepare a pure phosphate of lime, though working according to the instructions of the book. Solutions of bone-ash and Suffolk coprolites, made by treating them with hydrochloric acid slightly in excess of that required to dissolve carbonates and phosphates, on being boiled with pulpy phosphate of alumina (precipitated by ammonia) added, till a decided precipitate formed, gave me only phosphate of alumina, not a trace of phosphate of lime being found in the washed insoluble precipitate. The only action seemed to be the conversion of the gelatinous tribasic phosphate into the granular dibasic salt. Again, a hydrochloric acid solution of a very ferruginous Suffolk coprolite was treated with milk of lime until a permanent precipitate formed, then boiled, filtered, and washed thoroughly with boiling water. The washed insoluble precipitate was wholly phosphate of alumina and iron, and did not contain a trace of phosphate of lime. Dr. Morfit's method is based on the principle that when a hydrochloric acid solution, containing phosphates of lime, alumina, and iron, is neutralised with lime, none of the two latter precipitate until all the phosphate of lime has been thrown down; or that, in other words, phosphates of alumina and iron precipitate phosphate of lime. My results do not bear this out. Will Dr. Morfit explain where the error lies?

In testing these precipitates for phosphate of lime, I dissolved in hydrochloric acid, added ammonia until a permanent precipitate formed, then oxalic acid in excess, and oxalate of ammonia.

In his book, Dr. Morfit does not show the benefit which is going to accrue from the use of the pulpy oxides and phosphates of aluminum and iron as precipitants of the phosphate of lime in place of caustic lime. It certai[illegible]y does not save lime, and there will be the expense labour in obtaining the pulp.

Several plans for economising chloride of calcium are given by the Dr., two of which are novel.

By the application of sulphate of potash to chloride of calcium liquor he obtains precipitated sulphate of lime, and a solution of muriate of potash, the former of which he applies as a drier. It would be interesting for some manufacturer who purchases powdered gypsum at 15s. to 20s. per ton, to calculate what it would cost him to make it by Dr. Morfit's plan.

Mr. Townsend's phosphate of soda is to be transposed by his chloride of calcium into precipitated phosphate of lime and table salt! Will the price and demand for the latter compensate for the soda-ash or caustic soda thus destroyed? To use Dr. Morfit's favourite expression, this would be a "profligate application" indeed.

With regard to the analysis of mineral phosphates and artificial manures, I agree with Dr. Morfit that it is extremely desirable to ascertain what proportion of the phosphoric acid belongs to lime, alumina, and oxide of iron, but the process he gives fails to attain those results. As the individuality of these several phosphates is lost when obtained in the one solution, his method only gives the several proportions of oxide of iron, alumina, phosphates of iron, alumina, and lime, in the form in which they are determined, and not as they existed in the original sample. How he obtains oxide of iron and phosphate of magnesia in an acetic acid solution, and separates the oxide of iron by extract neutralisation with ammonia from the phosphate of magnesia, is a puzzle to me.

The estimation of the ammonia in manures, so important a matter, is done by a defective indirect method, not directly by distillation with lime or soda. After separating phosphates by adding milk of lime as long as a precipitate falls, filtering off, and boiling down the solution to dryness at 212°, then heating the residue to a temperature much short of redness, he notes the loss as chloride of ammonium. No account is taken of soluble organic matter, or a reaction between the ammoniacal salts and nitrates. As no determination of the total nitrogen by combustion with soda-lime is mentioned, any nitrogenous matter—blood, wool, bones—is entirely overlooked.

Reich's method for the estimation of nitric acid, inapplicable for manures, is the one Dr. Morfit recommends, but no effort is made by him to rid the residue of soluble organic matter or ammoniacal salts before igniting with the silicic acid, so that the loss by ignition will represent much more than nitric acid.

Finally, the citric acid method is laid down as a means for estimating the phosphoric acid in phosphates of alumina. Recent investigations have fully proven the superiority of the molybdic process for such determinations.

As Dr. Morfit claims for his work a considerable degree of scientific and practical accuracy, it would be well if the analytical directions were to be generally discussed. There can be no question of the importance of obtaining reliable and useful results in manurial analysis, and it would be desirable that Dr. Morfit should explain why he has chosen to depart from many of the well-known, though possibly effete, processes of chemical analysis.

Miles Platting, Manchester.

VOLUMETRIC ESTIMATION OF SMALL QUANTITIES OF ARSENIC AND ANTIMONY.

By A. HOUZEAU.

There does not exist a method sufficiently sensitive to ensure the exact and rapid quantitative estimation of arsenic and antimony, notwithstanding that even very small doses of these substances act energetically on the human body. I intend to prove that this is a problem that can be solved, and I quote the following results:—

I. The hydrogen compounds of arsenic and antimony are almost entirely and instantaneously absorbed by slightly-acidulated nitrate of silver (Dumas), according to the following formulæ, confirmed by analysis:—

$$6(AgO,NO_5)+AsH_3=6NO_5+3HO+6Ag+AsO_3,$$

which gives Ag=0·11574 As and—

$$3(AgO,NO_5)+SbH_3=3NO_5+3HO+3Ag+Sb,$$

which gives Ag=0·1867 Sb.

II. On this reaction, an accurate and sensitive process for the indirect estimation of arsenic and antimony according to the quantity of silver precipitated can be based, and also a direct process for the estimation of arsenic according to the proportion of arsenious acid formed.

III. *Indirect Process.*—This process is carried on in the following manner:—The substance containing arsenic or antimony, so prepared that it can be reduced by hydrogen, is placed in a Marsh apparatus in which hydrogen is evolved from pure zinc and pure hydrochloric acid. The gas is first conducted through a column of chalk (lumps of chalk put into a tube placed vertically), and next into a titrated solution of neutral nitrate of silver, which is then diluted with its own bulk of water, and acidulated with two or three drops of nitric acid, or, still better, by 0·5 c.c. of acetic acid, so as to prevent the precipitation of a certain quantity of arsenite of silver. The silver which remains in solution is estimated by means of a titrated solution of common salt (Gay-Lussac's process).

IV., V., VI. The estimation of the arsenic may be performed by the direct method, consisting in a chlorometric process with the silver solution which has been used for absorbing the anseniuretted hydrogen. For this purpose the whole of the silver is precipitated by a slight excess of a 3 per cent chloride of sodium solution; the volume of the liquid and precipitate is measured (say 25 or 50 c.c.), and the whole thrown on to a perfectly dry filter, which is not washed. The clear filtered liquid is first measured (say 22 to 40 c.c.), and then poured into a test-glass, and there is added to it 1 or 2 c.c. of perfectly pure and colourless hydrochloric acid. The quantity of arsenious acid is next estimated by means of a titrated solution of permanganate of potassa.

VII. I quote the following results as instances of the accuracy of both the indirect and direct methods—

Indirect Method.—Arsenic and antimony calculated from the loss of silver of the titrated solution—

Arsenic.		Antimony.	
Put in.	Found.	Put in.	Found.
m.g.	m.g.	m.g.	m.g.
3·33	3·36	5·00	4·82
9·99	10·18	10·18	9·88

Direct Method.—Arsenic estimated as arsenious acid by means of a titrated solution of hypochlorite of soda—

Arsenic.	
m.g.	m.g.
9·99	10·40
3·33	3·38

VIII. The methods, simultaneously applied, may be used to estimate with precision a mixture of arsenical and antimonial compounds, and also for the quantitative analysis of arseniuretted hydrogen mixed with antimoniuretted hydrogen. Example—

Total quantity of silver precipitated by the hydrurets of antimony and arsenic, 57·3 m.g.

Silver, precipitated by arseniuretted hydrogen, and calculated from the arsenic estimated as arsenious acid, 29·2 m.g.

Therefore, silver precipitated by antimoniuretted hydrogen, 28·1 = 5·24 m.g. of antimony.

Resumé.

	Put in.	Found.
Arsenic..	3·33	3·38
Antimony	5·00	5·24

IX. The method is also applicable to the estimation of arsenic and antimony mixed with organic substances, but it is necessary to first destroy these substances, by means of a method which I shall afterwards explain.

X. Although this method is only directly applicable to those antimonial and arsenical compounds which admit of being reduced by nascent hydrogen, such as arsenic and arsenious acids, antimonic acid, &c., the use of this method may be extended to sulphurets and phosphurets of arsenic, after the previous oxidation of these substances by means of hydrochloric acid and chlorate of potassa.

XI. This process of oxidation will always have to be resorted to when arsenic or antimony are to be detected in a combination of unknown composition, because sulphurous, sulphhydric, phosphuretted hydric compounds will affect the silver solution in the same manner as arseniuretted and antimoniuretted hydrogen.

XII. Pure hydrogen does not, as has been often stated by chemists, reduce the nitrate of silver solution.—*Comptes Rendus*.

COAL-TAR COLOURS.

By E. WALLER, E.M.

I HAVE attempted to collect, though imperfectly, the names of the various coal-tar colours, both commercial and chemical, together with their chemical formulæ, when those could be found. Many of the compounds here mentioned are not now in use as dyes, either because they are too expensive, or because their use is inconvenient, requiring too complicated a treatment or rare chemicals to fix them upon the goods, or because they have been superseded by dyes of better quality. Several colours, black especially, are usually produced on the fibre of the goods by printing them with various salts of aniline and rosaniline, and then with salts of copper, chlorates, &c. Most of the dyes called aniline blacks give, when dissolved, deep green solutions. Of those to which the formulæ are not given, the chemical formulæ are not as yet known, or they have not been given by those works to which I have resorted on the subject. The derivatives of aniline and toluidine are given together, as the two are with difficulty separated from each other, and in course of manufacture the separation is never attempted.

Colours Derived from Aniline or Phenylamine ($C_{12}H_7N$) *and Toluidine or Toluylanine* ($C_{14}H_9N$).

Reds.

Hydrochlorate of Rosaniline, $C_{40}H_{19}N_3,HCl$.
Called also—Aniline red, new red, magenta, solferino, fuchsine, anileine rougé, roseine, and azaline.

Acetate of rosaniline, $C_{40}H_{19}N_3,HO,C_4H_3O_3$.
Known also by the same names as the above.

Nitrate of rosaniline, $C_{40}H_{19}N_3,HO,NO_5$.
Known by the same names as the hydrochlorate; also as rubine and rubine imperial.

Dicodhydrate of trimethylchrysaniline—
$C_{40}H_{14}(C_2H_3)_3N_3,2(HOI)$.
Called also chrysaniline red.

Nitrosophenyline, $C_6H_6N_2O$.

Chemical formula unknown—
Xylidine, tar red, soluble ruby.

Blues and Violets.

These shade into one another so gradually that they cannot well be separated.

Hydrochlorate of monophenylrosaniline—
$C_{40}H_{18}(C_{12}H_5)N_3,HCl$.
Called also—Rosaniline violet, red monophenylrosaniline, and Hofmann's violet.

Hydrochlorate of diphenylrosaniline—
$C_{40}H_{19}(C_{12}H_5)_2N_3,HCl$.
Also known as rosaniline violet and Hofmann's violet.

Triphenylrosaniline, or triphenyl rosaniline—
$C_{40}H_{16}(C_{12}H_5)_3,N_3$.
Called also—Aniline blue, rosaniline blue, Hofmann's blue. Bleu de Paris, bleu de Lyons, bleu de Mulhouse, bleu de Mexique, bleu de nuit, bleu lumière, bleuine, azurine, and night blue.

Hydrochlorate of triphenylrosaniline—
$C_{40}H_{16}(C_{12}H_5)_3N_3,HCl$.
Known also by the same names as the above.

Acetate of triphenylrosaniline—
$C_{40}H_{16}(C_{12}H_5)_3N_3,HO,C_4H_3O_3$.
Known also by the same names as the above.

Bisulphotriphenylrosaniline acid—
$C_{40}H_{16}(C_{12}H_5)_3N_3,4SO_3$.
Called also Nicholson's blue and soluble blue.

Hydrochlorate of monethylrosaniline—
$C_{40}H_{18}(C_{12}H_5)N_3,HCl$.
Called also Hofmann's red violet.

Hydriodate of ethylrosaniline, $C_{40}H_{18}(C_4H_5)N_3,HI$.
Called also Hofmann's red violet.

Ethyliodate of ethylrosaniline, $C_{40}H_{18}(C_4H_5)N_3\ C_4H_3I$.
Called also fuchsine with a blue tint, and Hofmann's violet red.

Hydrochlorate of diethylrosaniline—
$C_{40}H_{17}(C_4H_5)_2N_3,HCl$.
Called also Hofmann's blue.

Ethyliodate of diethylrosaniline—
$C_{40}H_{17}(C_4H_5)_2N_3,C_4H_5I$.
Called also Hofmann's red violet and ethylic rosaniline violet.

Hydrochlorate of triethylrosaniline—
$C_{40}H_{16}(C_4H_5)_3N_3,HCl$.
Called also Hofmann's blue.

Ethyliodate of triethylrosaniline—
$C_{40}H_{16}(C_4H_5)_3N_3,C_4H_5I$.
Called also Hofmann's blue and ethylic rosaniline violet.

Ethylbromate of triethylrosaniline—
$C_{40}H_{16}(C_4H_5)_3N_3,C_4H_5Br$.
Called also brimula.

Hydrochlorate of methylrosaniline—
$C_{40}H_{18}(C_2H_3)N_3,HCl$.

Hydriodate of methylrosaniline, $C_{40}H_{18}(C_2H_3)N_3,HI$.

Hydrochlorate of dimethylrosaniline—
$C_{40}H_{17}(C_2H_3)_2N_3,HCl$.

Hydrochlorate of trimethylrosaniline—
$C_{40}H_{16}(C_2H_3)_3N_3,HCl$.

Methylaniline, $C_{12}H_6(C_2H_3)N$.
Called also methylic rosaniline violet and violet de Paris.

Mauvaniline, $C_{38}H_{17}N_3$.

Voilanile, $C_{36}H_{15}N_3$.

Mauveine, $C_{54}H_{24}N_4$.
Called also—Mauve, aniline purple, Perkin's violet, indisine, analeine harmaline, violine, and mauve rosolane.

Hydrochlorate of mauveine, $C_{54}H_{24}N_4,HCl$.
Known also by the same names as mauveine.

Hydrochlorate of ethylmauveine, $C_{54}H_{23}(C_4H_5)N_4,HCl$.
Called also dahlia.

Ditolylrosaniline, $C_{40}H_{17}(C_{14}H_7)_2N_3$.
Called also toluidine blue.

Tritolylrosaniline, $C_{40}H_{16}(C_{14}H_7)_3N_3$.

Chemical formulæ unknown—
Regina blue, opal blue, regina purple, bleu de Fayolle, violet de Mulhouse, Britannia violet, geranosine, violet imperial.

Greens.

——— $C_{40}H_{13}(C_4H_5)N_3,2HO$.
Known as—Aldehyde green, aniline green, viridine, and emeraldine.

——— $C_{40}H_{13}(C_2H_3)_6N_3,2HO$.
Known as iodine green and iodide of methyl green.

Chemical formulæ unknown—
Iodide of ethyl green, Perkin's green.

Yellows.

Chrysaniline, $C_{40}H_{17}N_3$.
Called also—Phosphine, aniline yellow, and yellow fuchsine.

Nitrophenyldiamine, $C_{40}H_6O_6,HCl$.

Chrysotoluidine, $C_{42}H_{20}N_3$.
Zinaline, $C_{40}H_{19}N_2O_{12}$(?).

Chemical formulæ unknown—
Dinitroaniline, Field's orange(?).

Browns.

Chemical formulæ unknown.
Havanna brown, Bismark brown, aniline brown, aniline maroon, Napoleon brown.

Greys.

Chemical formulæ unknown—
Aniline grey, argentine.

Black.

Chemical formulæ unknown—
Aniline black.

Colours Derived from Naphthaline or Naphthylhydrate ($C_{20}H_8$).

Reds.

Chloroxynaphthylic acid, $C_{20}H_5ClO_6$.
Called also—Pseudoalizarine, naphthylic red, and chloronaphthaline acid.

Chemical formulæ unknown—
Roseonaphthaline, carminaphtha.

Yellows.

Binitronaphthaline, $C_{20}H_6(NO_4)_2$.
Called also—Binitronaphthal, naphthalamine yellow, Naphthylic yellow, golden yellow, and Manchester yellow.
Binitronaphthylic acid, $C_{20}H_5(NO_4)_2O,HO$.
Known also by the same names as the above.
Trinitronaphthylic acid, $C_{20}H_4(NO_4)_3O,HO$.

Colours Derived from Carbolic Acid, and Phenic Acid, Phenylhydrate or Phenol ($C_{12}H_6O_2$).

Reds.

Picramic acid, $C_{12}H_5(NO_4)_2NO_2$.
Called also picramine acid.
Coralline, $C_{20}H_8O_4$.
Called also peonine.
Coralline amide, $C_{20}H_9NO_2$.
Called also red coralline.

Blue.

Isopurpuric acid, $C_{12}H_3(NO_4)_2NO_3,2Cl$.
Called also bicyanide of picramyl and Grénat.

Green.

Chemical formulæ unknown—
Chloropicrine.

Yellows.

Picric acid, $C_{12}H_2(NO_4)_3O,HO$.
Called also trinitrophenic acid and carbazotic acid.
Aurine, $C_{24}H_{12}O_6$.
Called also rosolic acid.

Browns.

Picrate of ammonia, $NH_4O,C_{12}H_2(NO_4)_2O$.
Isopurpurate of potash.

Chemical formulæ unknown.
Phenyl brown, or rotheine, or phenicienne.

Azuline (blue), $C_{24}H_{11}NO_4$, and another viridine (formula unknown) are both an aniline and a carbolic acid colour, being produced by the action of carbolic acid on a derivative of aniline.

Cyanine (blue), $C_{60}H_{33}N_2I$, is described in some works among the coal-tar colours, but is derived from chinchonine.

Among the blues and violets, the names Hofmann's blue or Hofmann's violet are seen frequently to occur. These are distinguished in commerce by suffixing the letters B or R the number of times that either is repeated, showing the relative blueness or redness of the dye. They range from BBBB to RRRR. The reddish shades are those n which the least substitution has taken place, as in the monethyl- or monophenyl-rosaniline, &c., while the bluest of these are those which are triethyl, triphenylrosanilines, &c. The series of names given for triphenylrosaniline and the hydrochlorate of the same base are frequently interchanged. On the ethyliodates and ethylbromates, authorities appear to differ as to whether they really are ethyliodates, &c., or not. The colours are prepared hy the action of iodide of ethyl, &c., upon rosaniline or some of its salts and iodine is given off in the operation, but whether one equivalent of the iodide of ethyl remains behind or not in a state of chemical combination does not appear to be fully established. Were the latter supposition the case, the C_4H_5I of those formulæ would be replaced by 2HO, and the chemical name would necessarily be changed to correspond. The same question might be raised regarding some of the Hofmann violets with their equivalent of HCl or $HO,C_4H_3O_3$, but as one of these acids is used in the solution when purifying the colour, the probabilities are that the base unites with it, and the colour goes to market as a salt and not as an isolated base. The terms, direct blues and purified blues,* are simply commercial terms indicating the amount of purification which the dyes have received, the first-named being the most impure. Among the greens the terms aniline green and emeraldine are synonymous terms applied to a colour formed in the fibre of the goods. Viridine is a name applied to a true green, but the term has also been used for a mixture of indigo and picric acid, which cannot properly be called an aniline colour.—*American Chemist.*

ON THE COMPOSITION OF THE LYES WHICH ARE OBTAINED BY THE OXIDATION AND LIXIVIATION OF SODA WASTE FOR THE RECOVERY OF SULPHUR.†

By C. STAHLSCHMIDT.

(Concluded from p. 67.)

Determination of the Sulphurous, Hyposulphurous, and Sulphuric Acids.—Generally the sulphurous and hyposulphurous acids are determined together, by adding to the lye a neutral solution of zinc sulphate or chloride, filtering and washing the zinc sulphide and sulphur, and estimating the acids in the filtrate by a standard solution of iodine. This method, however, has its disadvantages, for the mucous zinc sulphide is difficult to wash, and the quantity of acids is found too high, if the dissolved sulphuretted hydrogen is not driven off by warming before filtering. The method becomes easier and more convenient by substituting neutral manganese chloride for the zinc salt, because the manganese sulphide is washed more readily and completely. It is best to decompose the lye by carbonic acid, which is passed through it until all sulphuretted hydrogen is driven off; calcium carbonate and sulphur are precipitated, from which the liquid is readily filtered. The filtrate is then heated in order to precipitate the calcium carbonate dissolved in the free carbonic acid and then titred directly with solution of iodine. Experiments according to this method gave exactly the same results as those with solutions of zinc or manganese. In all instances the sulphite is converted into hyposulphite by the nascent sulphuretted hydrogen; therefore the quantity of iodine solution must be calculated for this acid. 25 c.c. lye on the average required 76·4 c.c. standard solution of iodine.

25 c.c. lye were precipitated with absolute alcohol, the precipitate filtered and washed first with alcohol and then with water in order to re-dissolve any precipitated hypo-

* See Reimann's "Handbook of Anilines," edited by W. Crookes, p. 126.

† Translated by M. Alsberg, Ph.D. From *Dingler's Polytech. Journal*, vol. 205, No. 3.

sulphites of sodium and calcium (the latter formed by decomposition). The remaining calcium sulphite together with the filter was brought into a beaker and titred with solution of iodine. 45·85 c.c. solution of iodine were used, corresponding to about 0·0032 grm. sulphurous acid. At the first titreing the sulphurous acid was present as hyposulphurous acid, therefore required only half the iodine solution = 22·9 c.c.; the hyposulphurous acid consequently required 7·64 – 22·9 c.c. = 53·5 c.c. = 0·0096 hyposulphurous acid. 25 c.c. lye contain therefore :—

$45 \cdot 85 \times 0 \cdot 0032 = 0 \cdot 1467$ sulphurous acid, and

$53 \cdot 5 \times 0 \cdot 0096 = 0 \cdot 5136$ hyposulphurous acid.

0·1467 sulphurous acid correspond to 0·275 calcium sulphite with 0·0733 sulphur, and 0·0917 calcium 0·5136 hyposulphurous acid give 0·8453 sodium hyposulphite with 0·3424 sulphur, and 0·2461 sodium.

25 c.c. lye gave 0·057 barium sulphate, corresponding to 0·033 calcium sulphate, with 0·008 sulphur and 0·01 calcium.

Determination of the Total Lime.—25 c.c. lye were mixed with an excess of ammonia, and the lime precipitated by ammonium oxalate. After well known manipulations 1·247 grms. calcium carbonate were obtained, corresponding to 0·499 grms. of calcium.

Determination of the Total Soda.—25 c.c. lye were boiled with hydrochloric acid until the precipitated sulphur had conglomerated, filtered, the lime precipitated by ammonia and ammonium oxalate, and the sodium in the filtrate weighed as chloride. Result—1·032 grms. sodium chloride, corresponding to 0·405 grm. sodium.

Determination of the Total Sulphur in 25 c.c. Lye.—5 c.c. lye were mixed with little water, and then powdered copper chloride was added; after the addition of fuming nitric acid heat was applied. The undissolved sulphur weighed 0·175 grm.; the sulphur in the form of barium sulphate 0·0756 grm.—together 0·2506 grm. sulphur. 25 c.c. lye contain, therefore, 1·253 grm. sulphur.

Determination of the Sulphydrate.—The sulphuretted hydrogen liberated from the sulphydrate in the lye by solution of iodine was estimated with a standard solution of potassa according to Mond's method. 25 c.c. lye required 43·75 c.c. potassa solution corresponding to about 0·00321 sulphuretted hydrogen. For the liberated molecule of sulphuretted hydrogen this amounted to 0·14 sulphuretted hydrogen, and for the total sulphur of the sulphydrates, therefore, 0·263 sulphur. If from the 0·405 sodium the sodium contained in the hyposulphite = 0·1461 is deducted, there remains 0·1589 sodium as sulphydrate; this weighs 0·3869 grm., with 0·1174 sulphuretted hydrogen. This quantity deducted from 0·14 grm., which were found, leaves 0·0226 grm. sulphuretted hydrogen for calcinm sulphydrate; these give 0·0704 grm. calcium sulphydrate with 0·0266 grm. calcium.

Determination of the Polysulphurets.—If, from the total quantity of sulphur, = 1·253 grms., there is deducted the sulphur of the sulphurous hyposulphurous and sulphuric acids, and of the sulphydrates, *i.e.*, 0·6867 grm., there remain 0·5663 grm. S; if the calcium of the calcium sulphite, sulphate, and sulphydrate is deducted from the total quantity of sulphur found, there remain 0·3707 grm. Ca, which are combined with the above 0·5663 sulphur to polysulphurets.

I have made the remark, that, bisulphide of carbon will take up sulphur from the lye. This observation, as well as that, that during the oxidation of the soda waste in the air sulphur is separated, proves, that besides the tetrasulphuret the lye must contain pentasulphuret and free sulphur. The two values for sodium and sulphur correspond to 1 mol. calcium, and 1·9 mol. sulphur, which might lead to the assumption of the compound CaS_2 in the lye. The presence of large quantities of tetrasulphuret in the lye, as well as the quantity of sulphur which is precipitated by carbonic acid, entirely contradict this view, not taking into account that Schöne has proved the non-existence of these compounds in solution. Again, it is not possible to assume the whole of the calcium as $4CaO.CaS_4 + 18aq.$, because in this case too large a quantity, $\frac{1}{4}$ of the total sulphur, ought to be present as free dissolved sulphur.

If we try to combine calcium and sulphur to tetra- and penta-sulphuret, the proportion representing the formula $CaS_5 + 4CaO.CaS_4 + 18aq.$, agrees best. According to this view 5 parts of calcium require 6 parts of sulphur; therefore 0·3707 calcium, 0·445 sulphur. The remainder of the sulphur 0·5663—0·445 = 0·1213 grm. is then dissolved as such. Therefore, 25 c.c. lye contain 0·309 CaS_5 with 0·0618 calcium, and 0·246 sulphur, 1·106 –

$$(4CaO.CaS_4) + 18aq.$$

with 0·309 Ca and 0·198 S.

By passing carbonic acid through the lye, only these two last compounds are decomposed with the separation of sulphur; the former yields $\frac{1}{5}$, the latter $\frac{3}{4}$ of its sulphur together, therefore 0·246. 0·8 + 0198.0·75 = 0·3453 S, to which must be added 0·1213 free sulphur, 0·4666 grm. altogether. The direct experiment gave 0·468 and 0·472, mean 0·470 grm. S, which quantity almost completely corresponds with the one calculated.

The investigation, furthermore, proves that carbonic acid must precipitate all the lime as carbonate, for the sodium sulphydrate, converted into carbonate, is present in sufficient quantity to completely precipitate the calcium sulphite. After decomposition by carbonic acid, boiling, and filtering, the lye contained no more lime.

If we review the results of the analyses, we find that 25 c.c. of the examined lye contained :—

CaS_5,	0·309	grm.
$4CaO.CaS_4 + 18aq.$,	1·106	,,
$CaSO_4$,	0·0333	,,
$CaSO_3$,	0·275	,,
$Na_2S_2O_3$,	0·8453	,,
CaH_2S_2,	0·0704	,,
NaHS,	0·3869	,,
S,	0·1213	,,

Behaviour of the Lye towards Sulphurous Acid.—Schaffner decomposes the lye by hydrochloric acid and passes the sulphurous acid, which appears after the sulphuretted hydrogen, into fresh lye, thereby converting the sulphurets into hyposulphites with the separation of sulphur; the hyposulphites are again decomposed by hydrochloric acid, sulphur being precipitated and sulphurous acid evolved. The sulphur resulting from this process contains considerable quantities of calcium sulphate, whose formation, according to Schaffner, is due to the sulphuric acid of the crude hydrochloric acid, whilst Mond, as has been mentioned, explains it by the formation of trithionic acid, which is formed during the decomposition, and later at an elevated temperature, is split into sulphuric and sulphurous acids and sulphur. The latter theory alone is correct, for the conditions of the formation of trithionic acid are existing under the given relations. Of course the calcium sulphate formed in this manner is increased by that from the sulphuric acid of the crude muriatic acid.

If pure washed sulphurous acid is passed through the sulphur lye, it is completely decomposed, considerable quantities of sulphuretted hydrogen being evolved and a yellow precipitate being formed, the temperature rising at the same time. In this case the action of the sulphurous acid was continued until lead paper was no longer coloured, the liquid had a neutral reaction, and did not, therefore, contain an excess of sulphurous acid. At this stage it contained calcium and sodium hyposulphite, and was completely free from sulphites. The filtered yellow precipitate was pure sulphur, free from calcium hydrate or sulphite, burning on platinum foil without leaving a residue. Consequently the decomposition does not take place in such a manner that difficultly soluble calcium sulphite is precipitated; but the sulphurous acid acts exactly like the carbonic or hydrochloric acid, it decomposes each single compound, sulphur and sulphuretted hydrogen being separated and combining with the bases,

it is instantly converted into hyposulphurous acid by the nascent sulphuretted hydrogen. This process, practised by Schaffner long since, is especially adapted to the manufacture of sodium hyposulphite; the lye, which has been treated with sulphurous acid until neutral, is decomposed either with sal-soda or soda ash; calcium sulphate or carbonate is precipitated, and there remains a concentrated solution of hyposulphite of soda, which after evaporation gives the salt almost pure. For lyes, which like the one examined can be completely purified from lime by carbonic acid, this process may be employed; but part of the sodium is then converted into carbonate. In this case, the sulphur being mixed with large quantities of carbonate of lime, might, perhaps, not be easily recovered.

If the lye, which has been neutralised with sulphurous acid and filtered, is again subjected to the action of sulphurous acid, no sulphur is precipitated, thus affording proof that the sodium hyposulphite is not decomposed; but if the liquid is heated on the water-bath, very soon a precipitate of sulphate of lime and sulphur is formed. In order to further elucidate this behaviour, a solution of pure calcium hyposulphite was heated, whereby according to the statements made hitherto, the salt ought to be split into calcium sulphite and sulphur. I have convinced myself, that even after protracted boiling this reaction is only a subordinate one, that, on the contrary, the salt is chiefly decomposed according to the formula $CaS_2O_3 + H_2O = CaSO_4 + SH_2$, calcium sulphate being formed and sulphuretted hydrogen evolved slowly but steadily.

If sulphurous acid is added to the solution of hyposulphite of lime and the whole heated on the water-bath, the liquid is coloured yellow, and after concentration suddenly a heavy precipitate of sulphate of lime appears, whose quantity cannot be compared with that formed without the addition of sulphurous acid. I was tempted to the belief that this decomposition takes place in this manner, because the sulphurous acid commences the process; this, however, is not the case, for if little sulphurous acid is added to the hyposulphite of lime, very little sulphur is precipitated, and the liquid contains sulphuric acid, but even after heating it on the water-bath for some length of time, no sulphate of lime is precipitated; only soon after adding an excess of sulphurous acid a heavy precipitate of sulphate of lime is formed. In the presence of sulphurous acid the decomposition of the hyposulphite of lime takes place in a different manner from that without it; the conditions for the formation of trithionic acid being given, first calcium trithionate is formed, which, on heating, is decomposed into sulphate of lime, sulphurous acid, and sulphur.

If the calcium hyposulphite is mixed with a little hydrochloric acid and heated, a precipitate of sulphur and sulphate of lime is formed; also in this case the sulphurous acid from the hyposulphurous acid has formed trithionic acid, which then was decomposed with the formation of sulphuric acid. If the quantity of hydrochloric acid necessary for the complete decomposition is added at once, no calcium sulphate is formed. The sodium salt behaves like the calcium salt; according to the quantity of hydrochloric acid it gives, when heated, sulphuric acid or not; in the latter case with an excess of hydrochloric acid the hyposulphurous acid being decomposed into sulphur and sulphurous acid.

The behaviour of the hyposulphurous acid in the sulphur lyes towards sulphurous acid is the same as that of the pure solutions of hyposulphurous acid, no matter whether the sulphurous acid be directly added or formed in the lye: the latter is always the case when the lye is decomposed by muriatic acid.

If the sulphur lye is heated to 60° C. and carefully mixed with hydrochloric acid, sulphur is separated and sulphuretted hydrogen evolved, but the sulphur re-dissolves, as I have already remarked. After a further addition of hydrochloric acid sulphur is precipitated, the lye is discoloured, and towards the last gives off sulphurous acid. This proves, that also here first the sulphurets and sulphhydrates are decomposed, and only later the sulphites and hyposulphites with the evolution of sulphurous acid. If the volume of the decomposed lye, which contains a certain quantity of free sulphurous acid, is just sufficient to convert into hyposulphites all the sulphurets and sulphydrates of the fresh lye which has been added, the process has been conducted faultlessly, *i.e.*, the smallest quantity of sulphate of lime is formed. If, on the contrary, the process of decomposing the lye is executed in such a way as to leave free sulphurous acid after the formation of those compounds, trithionate is instantly formed, which soon afterwards gives, by decomposition, sulphate, in our case calcium sulphate.

In Schaffner's process, where after decomposing the lyes by muriatic acid the free sulphurous acid is passed into fresh lye, a large quantity of sulphate of lime is formed, which seems to indicate that the quantity of sulphurous acid is too large. The reason, I think, is that the oxidised waste is very rich in hyposulphites, and that, therefore, by the decomposition of the lyes with muriatic acid too much sulphurous acid is liberated.

I am not able to precisely state how to operate on a large scale, for, as has been proved by others, the composition of the lyes is subject to great fluctuations; but the trithionates play an important part, as stated by Mond, and it is advisable to conduct the decomposition of the lyes by muriatic acid and the action of the sulphurous acid, or that of the decomposed lye on fresh lye, in such a manner as to exclude the formation of trithionates.—*American Chemist.*

PYROLOGY, OR FIRE ANALYSIS.*

By Captain W. A. ROSS, R.A.

(Continued from p. 70).

Fish-tail Flames.

25. If a pyrochromatic substance be held on the loop of a platinum-wire in a rapid hydrocarbonous current, produced by blowing strongly, the current is broken upon it so as to form a kind of fish-tail flame at its rear, *i. e.*, the side turned *from* the base of the pyrocone, in the blue matter of which its front is enveloped as usual. The inner sides of this fish-tail flame will, after a short time, be observed to be deeply and continuously tinged with the colour which is the chief characteristic of the substance burned.† A far stronger pyrochromatic reaction is thus obtained than by holding the substance in the position usually adopted, of what is called "the point of the outer flame," or, in fact, in an oxyhydrogen pyrocone; for here the superposed blast is too violent, and carries away the colour as soon as formed.

The Oxyhydrogen Pyrocone. (O. P.)

26. In which the object is held as at *a*, Fig. 1. It is commonly called "the oxidating, oxidising, or outer flame;" but that the two first of these appellations are incorrect is shown by the fact that when some metallic oxides, as those of gold, silver, or mercury, dissolved in a flux more delicately sensible to oxidation and reduction than borax or microcosmic salt, viz., phosphoric acid, are held in this position, the bead, so far from being further oxidised, immediately precipitates its contents, and becomes dim or opaque in consequence.

27. This pyrocone appears to be caused by the intermingling of the two currents—of air and ignited hydrocarbonous matter, its broadest part being at *a*, where they may be supposed to cross each other, giving it a slightly oblate appearance.

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* Communicated by the Author. From the *Proceedings of the Royal Society.*

† The substance should occasionally be dipped in distilled water.

The Peroxidising Pyrocone. (P. P.)

28. In order to produce the full effect of this pyrocone, the object must be held at a distance of 3 inches from the point of the blue. It can be produced, but not long sustained, by the mouth, as a very strong blast is necessary to impart sufficient heat to an object at such a distance (3, Fig. 1).

The Bunsen Blowpipe.

29. Before leaving the subject of pyrocones, it is necessary to mention that the ingenious blowpipe of Bunsen, by which the breath is *forced* into a jet of ignited gas itself, is utterly useless for the purposes, and to produce the results detailed in these pages. The pyrocone thus formed is indeed the counterpart of that produced by blowing into the pyrocone of a spirit-lamp, except that its temperature is perhaps higher, with the deleterious results mentioned in paragraph 12.

The Fluxes.

30. These are invariably supported on platinum-wire in the admirable and perfect manner invented by Gahn, and, as soon as a pyrocone is applied, assume the form of a spheroidal bead, which revolves or spins round upon its centre with a rapidity proportional to the fluidity of the matter of which it is composed. The "glasses" or "beads" thus formed, with the oxides dissolved in them, may be quantitatively determined, as to their weight and size, by means to be presently described.

31. Berzelius informs us that "Cronstedt used but three reagents—basic carbonate of soda, borate of soda, and the double salt of phosphate of soda and ammonia. These reagents are still in use; and among the great number of those which have been tried since that time, not one has been found to replace either of these. It is singular enough that, in the very beginning of the art, the very best reagents should have been hit upon." ("Berzelius on the Blowpipe," p. 32).

32. One of the objects of this paper is to attempt to show that the two last fluxes mentioned in the above paragraph are not only *not* "the very best reagents," but that they have, by the complicated and obscure results obtained necessarily from their compound nature, seriously retarded the progress of pyrognostic examination. For instance, speaking of the third flux mentioned, the metaphosphate of soda, produced from what is commonly called microcosmic salt, Berzelius says (p. 39),—"Its efficiency as a reagent depends principally on its free phosphoric acid; and it is preferred to this because the phosphoric acid cannot be kept without deliquescing, while at the same time it is much dearer, and is also easily absorbed by the charcoal. The salt of phosphorus shows, therefore, the action of an acid upon the substance to be tested."

Phosphoric Acid (Symbol Ᵽ).

33. Now, if glacial phosphoric acid be heated until it melts into a substance of viscid or gum-like appearance, and be thus poured hot into a wide-mouthed stoppered bottle (which should also be hot when receiving it), it can not only be kept without deliquescing, but, when solidified by cooling in the bottle, may be carried about in the pocket without fear, kept for years in the most rainy climate, and allowed to remain, even for hours, with the stopper of the bottle off. It has also the great advantage of being now-a-days far more easily procured pure enough for the purpose from most respectable chemists, even in out-of-the-way stations, as in India, in consequence of its use in therapeutics, than microcosmic salt can be. It is used by simply dipping the red-hot platinum-wire loop and the glass, of whatever description, formed upon it into the bottle, when a fresh supply of phosphoric acid adheres to the hot bead, without the supply in the bottle being at all adulterated.

34. That the metaphosphate of soda does *not*, when heated, exert upon substances added to it the reactions of an acid, unless the basic soda be displaced by another base for which the acid possesses a greater attraction, must be evident to an ordinary chemist; and there would appear to be few substances for which phosphoric acid has a greater attraction than it has for soda; in fact, the most valuable pyrognostic reactions *prima facie* of the acid upon substances have been lost to operators precisely because the salt it forms with soda *fails* to give us those acid reactions. as follows:—The acid effervesces violently with all carbonates, and with some of the metallic oxides, —the salt does nothing of the sort; and the necessity felt by many mineralogists and geologists of carrying about in their pockets a phial of the unpleasant and dangerous hydrochloric or nitric acid is thus at once obviated.

35. The *acid* used to dissolve cobalt oxide in any considerable proportion is blue-hot, but assumes on cooling a magnificent red-violet colour,* to which the modern word "magenta" is partly applicable. When soda or potash is applied to this glass in sufficient proportion (about 17 per cent) to form the metaphosphate of those bases, the glass remains blue, and a standard of alkali for purposes of calculation is thus evidently obtained. But as cobalt oxide produces with this flux many shades of colour, according to the quantity in which it is added, from a pale and scarcely perceptible pink to the deep crimson-violet above mentioned, and as these degrees of red are exactly azurised † by a corresponding strength or quantity of the alkali added, it is plain that a kind of chromatic scale or table of colours might thus be made of great use in the quantitative measurement of alkalies on the one hand, or of cobalt oxide on the other, instead of the unvarying "blue" which we find opposite oxide of cobalt in all blowpipe tables.

36. Instead, therefore, of superfluously multiplying illustrations of the difference between the reactions of the pure acid used as a flux and of the assumed "free acid" in microcosmic salt, it will be better to give here in slight detail some of the more important of the former with various oxides.

Gold.

37. Is dissolved and oxidised by this flux in an O. P. (as at *a*, Fig. 1), when added in minute portions of the leaf,—a fact which suggests that Ᵽ under these conditions is more powerful as a solvent than any one of the mineral acids. As stated in paragraph 26, the position (*a*, Fig. 1) will precipitate the dissolved gold oxide, rendering the bead of a dirty or muddy appearance, which the application of a P. P. (as at 3, fig. 1) will soon remove, the bead then appearing not merely diaphanous, but highly refractive. If this brilliant auriferous glass be now treated with a good H. P., the white metallic-looking film referred to in par. 15 is formed, with a slight but distinct shade of yellow-like pinchbeck, which is apparently due to the gold in solution; and this bead may thus be made alternately diaphanous and metallic-looking as often as is desired.

38. If the auriferous transparent bead be carefully kept for some time about ½ an inch from the point of the whole pyrocone, or 2 inches from the blue, as at 2, Fig. 1, a beautiful shade of bluish-rose-colour flushes over it just as it is becoming cold; ‡ and the production of this tint, which cannot be confounded by the dullest observer with the red-violet of cobalt, or the amethyst tinge of titanic acid or manganese, is an excellent test of the skill of the operator, as well as of the delicacy of the pyroconical reactions in this flux, for a hair's breadth too far towards 3, Fig. 1, will cause the glass to be diaphanous and colourless on cooling; while a corresponding error in the other direction towards 1 will, as has been mentioned, produce a muddy appearance.

39. Gold-leaf is more rapidly dissolved, and the above reactions more easily produced in a glass of *phosphate of lime*, which appears to be, under pyrological conditions, a

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* Discovered by the writer on July 12th, 1869.

† Lithia and its salts will not apparently azurise this cobaltine glass, but afford with it a very pretty purple-violet colour.

‡ The addition of fresh phosphoric acid at this stage brings out this beautiful reaction still more decidedly.

more powerful solvent of metallic oxides than any other known flux. It will be afterwards described; but it has the disadvantage in analysis, referred to in par. 32, of being a salt.

40. The ruby colour bestowed by gold upon glass and fluxes would thus appear, by the experiment above detailed, to be due to an *exact* amount of oxidation. The oxides of tin and and antimony, added with it to colour-glass under the name of "purple of Cassius," &c., seem not to have anything to do with the production of the colour.†

Silver.

41. The most infinitesimal trace of the oxide, or of a salt of silver, added to a bead of Ᵽ, gives a copious yellow precipitate like cream, accompanied at *first*, if the bead be held in a P. P., as at 2 or 3, Fig. 1, by a very beautiful but very transient rose-colour. This is such a delicate reaction for silver that it will be at once obtained from most galenas; and although thus a most important test *qualitatively*, is too fine to admit of being used as a quantitative standard for the estimation of rich ores.

42. There are two ways of effecting this. First, for an ore supposed to contain only a small percentage of silver. If the slightly argentiferous glass be retained in the position 3, Fig. 1, the yellow precipitate soon disappears, and the glass becomes clear, highly refractive, and brilliant. On changing its position in the pyrocone to that of *a*, Fig. 1, at present called the "oxidising flame," the yellow precipitate immediately and copiously reappears; but there is no visible mark or signification by which the operator can thus judge of the quantity of silver oxide added. When, however, this amounts to 5 per cent of the whole glass, and the latter, rendered diaphanous by the first position, is suddenly and momentarily brought into the second one indicated above, or, better, to just the tip of the blue, from whence, however, it must be instantaneously removed, a very remarkable and very beautiful appearance results. It is that of an almost perfect imitation of a pearl, produced apparently by the reduction of the oxide *near* the surface to the metallic state, while a vitreous glaze or gloss is still retained *upon* the surface.

43. This, then, may be called the first standard of silver for ores containing that oxide up to 5 per cent, though of course it may be used for richer ones; but the following method is more rapid for a rich ore, provided there are no chromatic oxides present to interfere with the clearness of the glass.

44. Second, for rich argentiferous ores. If we continue adding oxide of silver to a weighed Ᵽ glass, and dissolving it carefully as at 3, Fig. 1, we shall find the glass remains diaphanous until 20 per cent of the oxide has been added, when the yellow creamy precipitate again begins to appear, causing, for rich ores, 20 to be the standard of silver. Of course, in calculating results from these "standards," the ratio deducible from them must be of the *inverse* kind; that is, for instance, if we find an argentiferous ore requires to be added to the extent of 40 per cent in order to produce the yellow precipitate in a P. P., as at 3, Fig. 1, or just double the quantity of the pure oxide of silver to effect the same result, we take the proportion of Ag as just half of purity, or 50 per cent.

Mercury and the Volatilisable Metals in Ᵽ.

45. If these oxides are taken upon the hot glass, and the mass inserted into a good H. P., as in Fig. 4, they are neither volatilised nor dissolved. The volatile oxides under such conditions form part of the metallic-looking crust or film, which is invariably formed over the surface, and can thus be added in large quantity with a very trifling loss. If the mass be now treated with a P. P., as at 3, fig. 1, these oxides are rapidly dissolved, all of them bestowing on the Ᵽ glass a brilliant golden-yellow, especially arsenic acid, by which a glass is thus produced quite equalling in appearance the finest topaz.

46. If this glass be now returned to an O. P., as at *a*, Fig. 1, the oxide is immediately precipitated with a dim, and often an opaque grey or grey-black, appearance; and although mercuric oxide (for instance) is usually presumed to be of so volatile a nature that its reactions are not given in blowpipe tables, this mercurial oxide is so difficult to volatilise that the strongest O. P. will not clear the Ᵽ bead from it, but only burn both slowly away.

Sulphur.

47. If sulphur be added to a Ᵽ bead, as described in par. 45, and then treated with a P. P., the curious result of chromatic reactions exactly similar to those of copper, *i. e.*, green hot and blue cold, is produced. The addition of plumbic oxide heightens this effect; and the resulting blue bead is quite indistinguishable from a cupreous one placed alongside.

Nitrogen.

48. If a Ᵽ bead be constantly dipped in the strongest possible solution of ammonia or in concentrated nitric acid, and immersed as often in a H. P., as Fig. 4, numerous black specks will be found on the surface like carbon, but much more difficultly burned away After a time these appear to combine with the metallic-looking film which is formed by the H. P., and the substance is then by no means easily volatilised. The glass thus impregnated with nitrogen will be found to be clear hot, yellow and gelatinous on cooling, therein exactly differing from those of the alkalies, the volatilisable oxides, and some of the earths, which are yellow hot and clear cold.

Oxide of Copper in Ᵽ.

49. If we add pure cupric oxide to a weighed Ᵽ bead, and treat it with a P. P. (2, Fig. 1), we find that it takes exactly 5 per cent of the whole bead to produce distinctly the peculiar *blue* of copper. The glass must be carefully held in the position indicated, as O. P. would leave it *green*:* 5 per cent, then, may be taken to represent the standard of copper for quantitative measurements, as described in par. 44; but in such cases as Cu pyrites, where there is a chromatic interference of other oxides, something more is necessary.

50. It requires one-third more than the weight of a Ᵽ glass in sulphur to give it the cupreous blue appearance referred to in par. 47; that is to say, a 50 mgrs. glass of Ᵽ requires 75 mgrs. of flour sulphur added by degrees for that purpose. But it is found that by treatment in H. P. the flour sulphur, when it assumes the metallic appearance referred to in par. 17, is reduced to one-fifth of its bulk; so that 75 mgrs. of flour sulphur only represent 15 mgrs. of the allotropic sulphur, and 15 therefore is taken as the standard of sulphur. It has also been ascertained that 16 mgrs. per cent of oxide of copper, when added to this sulphurous Ᵽ bead, cause it to remain *green* even after a P. P., probably on account of the disposal by the sulphur of the superfluous oxygen; 16, therefore, is taken as the equivalent standard of copper to sulphur. If we now add oxide of lead to the *green* cupreo-sulphurous Ᵽ bead thus produced, we shall find that, on the addition of 24 mgrs. per cent, the glass will again appear blue; 24, therefore, is taken as the equivalent standard of PbO to sulphur.

51. Copper pyrites dissolved in a Ᵽ glass has a dirty green appearance, without any shade of blue in it, after a P. P. As an example, it took 57·1 mgrs. of PbO to azurise a green Cu pyrites Ᵽ bead of 100 mgrs.

$$\text{Then } \overset{\text{PbO}}{24} : \overset{\text{S}}{15} :: 57{\cdot}1 = \overset{\text{Per cent.}}{35{\cdot}6} \text{ sulphur.}$$

$$24 : \overset{\text{Cu}}{16} :: 57{\cdot}1 = 38{\cdot}0 \text{ copper.}$$

Therefore the oxide of iron = 26·4 iron.

This is not very wide of the actual composition of Cu pyrites as decided by chemical analysis,—which is sul-

† No metal, not even gold, has any tendency to alloy the platinum-wire in this flux when kept under a P. P. [Phosphofluate of lime gives with gold oxide a bead as blue and brilliant as a sapphire,—September 14th, 1872.]

* This is not the case with borax or microcosmic salt.

phur, 34·9; copper, 34·6; iron, 30·5. The specimen treated was a rich one from Freiberg, in Saxony.*

52. With rich ores, as the red oxide, the method (par. 49) is so delicate, that an assay roasted *through* platinum foil gave 4 mgrs. more in the hundred than it did unroasted. The best and safest plan is to have an azure Ᵽ glass coloured with 5 per cent of CuO as a pattern, and place the assay alongside of it on a sheet of white paper.

Titanium and Tin in Ᵽ.

53. A diaphanous Ᵽ glass having either of these oxides dissolved in it will, after being held a considerable time, as at 3, Fig. 1, show (apparently) crystals, yellow with Ti, and white with Sn, produced in it. This result cannot be effected with the mouth, but only with a table pyrogene.†

Alumina and Silica in Ᵽ.

54. Berzelius proposes (p. 86) to estimate silica pyrognostically in a mineral thus:—"Every substance of an earthy or mineral nature, which melts with *soda* with effervescence into a transparent glass which remains transparent on cooling, is either silica or a silicate in which the oxygen of the silica is at least double the quantity of that of the base." This ingenious discovery, which is strictly correct in cases where it is applicable, and in such cases therefore most useful, is unfortunately inapplicable to those silicates in which the estimation of the silica is of the most importance. The so-called "alkaline earths," especially *lime*, will not permit silica, though combined in any proportion, to yield a bead with soda transparent on cooling, and they seem also to prevent or cancel effervescence in the same.

55. After many comparatively futile attempts to separate and estimate alumina and silica in various ways, one of which is referred to in par. 18. which occupied the writer some years, the following plan, which ought from its simplicity to have suggested itself at first, has been followed with apparent success. Nearly every oxide or substance is more soluble pyrologically in Ᵽ than alumina and silica, while alumina is far more soluble than silica is. The "alkaline earths" are rapidly dissolved; and lime especially is not only dissolved, but forms a salt, referred to in par. 39, which will dissolve almost anything but silica.‡

56. It has been ascertained that alumina will dissolve to the extent of 20 per cent, and silica to that of only 6 per cent, in a Ᵽ bead; and this result is not materially modified by lime. After those amounts respectively have been added, the undissolved alumina appears as white roundish fragments, like pieces of fat, the silica as a semitransparent mass like melting snow, so that they are thus distinguished without difficulty even in presence of lime or the alkaline earths. Six per cent is therefore taken as the standard of silica in quantitative calculations; but as 20, that of alumina, is inconveniently large, it is better to employ as the flux a Ᵽ bead half saturated with 10 per cent of pure alumina, and to make 10 the standard of that "earth."

57. A Ᵽ glass saturated with silicic acid still dissolves a little alumina, but the converse is not the case; it is best, therefore, to test *qualitatively* for either earth with a Ᵽ glass saturated with *alumina*.

(To be continued.)

* Another mode of procedure with sulphides is to carefully add the roasted ore (which by a method of roasting to be hereafter described, *invariably* loses *just* 17 per cent), atom by atom, to the P bead, in a P. P. (when the CuO blue reaction will *first* appear), until the FeS *begins* to interfere with it; then deduct from the large amount of copper thus indicated the sulphur and iron as determined by roasting and protoxide of lead.

† Such as are sold at Freiberg by "Herr Bergmekanikus Lingke," manufacturer to the Royal University of that place; *vide* Plattner's "Probirkunst mit dem Löthrohre," vierte Auflage (Leipzig, 1865), p. 31, note.

‡ Borax dissolves silica pyrologically more completely than any known flux. The writer found that phosphoric and nitric acids, combined in about equal proportion, attacked and broke up the Berlin saucers in which they were boiled.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 6th, 1873.

Dr. Williamson, F.R.S., Vice-President, in the Chair.

After the minutes of the previous meeting had been read and confirmed and the donations to the Society announced, the names of Messrs. James Walker Montgomery, Alexander Bottle, Richard Joseph Deely, and George Ainsworth, were read for the first time; for the third time, Messrs. Charles Lees, John Abigal Bower, Miles H. Smith, George Frederick Ochacht, Alfred J. Cownley, and Walter E. Koch, who were ballotted for and duly elected.

The first communication was from Dr. H. E. Armstrong, "*On the Action of Sodium on Aniline.*" The author said that he was induced to lay before the society the results of his experiments on this subject some years ago, as Messrs. Merz and Weith had recently stated that sodium had no action on aniline. This was correct for temperature below the boiling-point of aniline, but when the two substances are heated in a sealed tube to 200°, the sodium disappears, hydrogen is evolved, and a colophonium-like substance produced, which appears to be a mixture of—

$$N\begin{cases}C_6H_5\\Na\\H\end{cases} \quad \text{and} \quad N\begin{cases}C_6H_5\\Na\\Na\end{cases}$$

It darkens when exposed to the air, and is decomposed by the action of water, with formation of sodium hydrate and reproduction of aniline. With methyl-aniline the action is only partial even at 250°, and with ethyl-aniline there is no action even at 300°. The simultaneous action of potassium and carbonic anhydride on aniline gives rise to potassium carbonate and diphenyl carbamide—

$$N_2(C_6H_5)_2H_2CO.$$

The latter substance, however, is not always produced, and even under favourable circumstances the amount is but small.

The Chairman, after thanking Dr. Armstrong for his interesting communication, announced that a paper "*On Anthrapurpurine*" would now be read by the author, Mr. W. H. Perkin. After adverting to a paper in which he had mentioned the existence of another colouring matter, differing from alizarine, which was present in crude artificial alizarine, the author stated that he had endeavoured to extract it by repeated crystallisation of the alizarine from various solvents, but, although its solubility differs considerably from that of alizarine, he had been unsuccessful. The method of preparation ultimately adopted was to dissolve the crude colouring matter in a dilute solution of sodium carbonate, and agitate it with freshly precipitated alumina, which removes the alizarine in the form of a lake, and precipitate the impure anthrapurpurine from the filtered solution by hydrochloric acid. This product was purified by repeatedly boiling it with alcohol, crystallising the residue from glacial acetic acid, boiling it with alcoholic soda and decomposing the difficultly soluble sodium compound with barium chloride. The barium compound was lastly decomposed by sodic carbonate, and the resulting purple solution precipitated by hydrochloric acid. The product obtained, after being crystallised two or three times from glacial acetic acid, was found to have the composition $C_{14}H_8O_5$. *Anthrapurpurine* sublimes with partial decomposition when heated, is difficultly soluble in alcohol and in ether, but soluble in hot glacial acetic acid, which deposits it in tufts of minute orange-coloured needles. When heated with acetic anhydride to 150° it dissolves, forming *tri-acetyl-anthrapurpurine*, $C_{14}H_5(C_2H_3O)_3O_5 = C_{20}H_{14}O_8$, a substance crystallising in pale yellow glistening scales, which melt at 220°-222°. It is moderately soluble in glacial acetic acid, and is decomposed when heated with

alkalies, anthrapurpurine being regenerated. It dissolves in strong nitric acid, forming a dark yellow solution, which yields a pale brown precipitate when diluted with water. Diacetyl-alizarine, treated in a similar manner, yields a crystalline compound, which dyes alumina mordants a bright orange. By treating anthrapurpurine with benzoyl chloride, a corresponding crystalline *tribenzoyl-anthrapurpurine*, $C_{14}H_5(C_7H_5O_3)_3O_5 = C_{35}H_{20}O_8$, is obtained of a dark yellow colour. It melts at 183°-185°, and is moderately soluble in glacial acetic acid. From these results the author inferred that anthrapurpurine may be regarded as anthraquinone in which three of hydrogen are replaced by three of HO, so that it would have the formula $C_{14}H_5O_2(HO)_3$, and is probably derived from a trisulpho acid of anthraquinone. When heated with aqueous ammonia to 100°, a dark purple-coloured compound is obtained, which is probably isomeric with Dr. Stenhouse's purpurine. The author also gave a brief account of the action of bromine and nitric acid on anthrapurpurine, and concluded with a description of the absorption-spectra of anthrapurpurine and of its dyeing properties. The paper was illustrated by many striking experiments.

Dr. Williamson, in thanking Mr. Perkin for his interesting contribution to the history of the colouring matters, said it was a matter of surprise to him that the author exhibited such activity in contributing to the extension of the domain of science whilst he was at the same time conducting manufacturing operations on an extensive scale.

The next paper, on "*Isomerism in the Terpene Family of Hydrocarbons*," was read by the author, Dr. C. R. A. Wright. The investigation detailed in the paper was made with the hope of obtaining some insight into the isomerism of the various members of the terpene hydrocarbons, and for this purpose the oils of nutmeg and orange-peel were selected for examination. By careful fractional distillation of the former, hydrocarbons boiling between 163° and 166°, and 173° and 177°, were obtained, also an oxidised substance, the *myristicol* of Dr. Gladstone, boiling between 212° and 218°, but this appears to become polymerised by repeated distillation. On treating the fraction between 163° and 166° with concentrated sulphuric acid to polymerise the terpene, a certain quantity of a hydrocarbon boiling between 173° and 177° was ultimately obtained. This, which amounts to about 8 per cent, had all the properties of cymene.

On fractionally distilling the oil of orange-peel, almost the whole passed over between 175° and 180°, the proportion of the oxidised constituent corresponding to myristicol being but very small. The hydrocarbon, *hesperidine*, from this oil does not appear to contain any cymene, as it yields no terephthalic acid on oxidation; on submitting it to the action of potassium dichromate and sulphuric acid, much carbonic acid is evolved, and a somewhat viscid oil remains, which by fractional distillation yields an oxidised compound, $C_{10}H_{16}O$. The hydrocarbon from nutmeg oil, boiling between 163° and 166°, when treated in a similar manner, yields a small quantity of an oxidised substance closely resembling myristicol. By the action of dilute nitric acid on hesperidene, *hesperisinic acid*, an acid analogous to camphresenic acid, is obtained, whilst the hydrocarbon from nutmeg oil by similar treatment yields toluic and terephthalic acids, and a new acid, *myristicinic acid*. Hesperidine combines readily with gaseous hydriodic acid, but does not form a crystalline compound, and, when treated with hydriodic acid and phosphorus, becomes polymerised. The author infers from the results of his examination that the hydrocarbons from turpentine, nutmeg oil, and orange-peel are truly isomeric, and concludes his paper with some remarks on the possible dissected formulæ for the isomerides of the general formula $C_{10}H_{16}$.

The Chairman, after thanking the author for his elaborate research on this interesting and important subject, adjourned the meeting until Thursday, Feb. 20, when the following papers will be read:—"On Aurin," by R. S. Dale and Dr. C. Schorlemmer, F.R.S. "Researches on the Action of a Copper-Zinc Couple on Organic Bodies; I. On Iodide of Ethyl," by Dr. Gladstone and A. Tribe. "Solidification of Nitrous Oxide," by Mr. Wills. "Action of Hydrochloric Acid on Codeine," by C. R. A. Wright.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 7th, 1872.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

Mr. Julius Allmann was elected an ordinary member of the Society.

The President referred to the great loss which the Society had experienced by the death of one of its most distinguished honorary members. Dr. Rankine was one of the earliest investigators of the dynamical theory of heat, and contributed eminently in the work of bringing that theory to its present advanced condition. Besides this, he was perhaps more successful than any other man in applying his own discoveries, and those of his fellow labourers in abstract science, to practical use. His treatises on the steam-engine and other prime movers, applied mechanics, machinery, &c., form what may justly be termed an encyclopædia of civil engineering. Called away in the prime of life, his loss is one of the most severe that could have befallen science.

Mr. William H. Johnson, B.Sc., called attention to the action of sulphuric and hydrochloric acids on iron and steel.

If, after immersion for, say, ten minutes in either of these acids, a piece of iron or steel be tested, its tensile strength and resistance to torsion will be found to have diminished. Exposure to the air for several days or gentle heat will, however, completely restore its original strength. On breaking a piece of iron wire after immersion in sulphuric acid, and gently moistening the fracture with the tip of the tongue, bubbles of gas arise causing the wetted portion to appear to boil. The most careful washing and coating with lime, after being dipped in the acid, and even its subsequent drawing, in which process it is reduced in diameter by passage through a die, does not interfere with either of these phenomena; which only gradually disappear by exposure to the air, or more quickly by gentle heat.

Prolonged immersion in acid has a tendency to produce a crystalline structure in even the best wrought-iron.

NOTICES OF BOOKS.

Ozone and Antozone; their History and Nature. By C. B. Fox, M.D. London: J. and A. Churchill.

Few bodies have, during the past thirty years, engrossed a larger share of the attention of chemists, meteorologists, and physicians, than the subject of this elaborate monograph. Yet how small is the amount of definite results which have been attained. We know, indeed, that ozone is oxygen in an allotropic state, and that these two bodies can be mutually converted into each other without either the addition or withdrawal of any other body; we are acquainted with certain of its reactions and with divers methods for its preparation. We consider it highly probable that its formation depends on the condensation of oxygen into two-thirds of its former volume. We consider that antozone is not, as was first supposed, a mere antagonistically active form of oxygen, but a peroxide of hydrogen. But having advanced so far, we abandon the region of science for that of conjecture and contradiction. If we ask when is ozone observed in the atmosphere, we

are told by one authority that it is always present, and that the "variation in its amount is inappreciable," whilst another observer pronounces it "an element of the most fluctuating quantity." Some find it most plentiful during the prevalence of northerly, and others of southerly winds. At Versailles, it was observed to be most abundant in summer; at Strasburg, in spring, and elsewhere in winter. Prestel finds its yearly maxima at the equinoxes and its minima at the solstices.

Nor, if we turn to the consideration of its supposed sanitary effects, do we find much greater agreement. It is, indeed, generally admitted that the air of large cities contains little or no ozone, whilst in country districts, on the coasts, and out at sea, it is comparatively abundant. In hospitals, especially in the fever wards, it is almost entirely absent. From such circumstances, and from its admitted power of destroying unpleasant odours, it is ordinarily pronounced to be "nature's grand disinfectant," and its presence is considered a safeguard against the spread of zymotic disease. Thus, according to Dr. Moffat, the cattle-plague was found most prevalent in those parts of England where ozone is generally supposed to be least plentiful. But all this, as the author reminds us, is far from proved. Thus at Königstadt, an unhealthy town, ozone was found as abundantly as upon the healthiest mountain. At Vienna, "a city noted for its lung-diseases and typhoid fevers," the indications of ozone were more decided than at Prague, "which is justly ranked with the healthiest towns." "We are not *sure*," says the author, "that ozone possesses the power of oxidising the *materies morbi* of any known affection."

Before these and kindred questions can be finally decided, our observations of the presence and quantity of ozone in the atmosphere must be freed from their discrepancies and contradictions. To do this our test-methods stand in need of a thorough verification. Into this part of the subject Dr. Fox enters at some length, pointing out the circumstances under which they become untrustworthy. For these precautions and for many valuable suggestions on the mode of observation, we must refer to the work itself.

Year-Book of Pharmacy, with the Transactions of the British Pharmaceutical Conference. London: J. and A. Churchill.

A valuable abstract of researches, novelties, and improvements, interesting to the pharmaceutical profession, arranged under the heads of *materia medica*, pharmaceutical chemistry, pharmacy, and "notes and formulæ." The transactions of learned societies and the scientific journals, foreign as well as British, appear to have been carefully explored for useful and appropriate matter. The opening address of Mr. Brady, at the Brighton Pharmaceutical Conference, and the papers on pharmaceutical education read by Messrs. Attfield, Schweitzer, and Proctor, are of deep interest beyond the immediate boundaries of the pharmaceutical profession. We gladly hail the denunciation of "cram" and the admission that—"Examination *per se* never was, and probably never can be, a thorough test of competency," a dictum which ought to be inscribed in letters of gold over the door of every college in the land. But whilst congratulating our pharmaceutical friends on the advance they have made, and on their success in raising their *status*, we cannot help putting the question whether some corresponding movement cannot be made among "analytical and consulting chemists?" Is it impossible for us to prevent the intrusion of incompetent persons from without, and to establish a code of professional ethics within? It is painful to hear of analytical chemists offering to perform investigations for fees which cannot cover the outlay for pure reagents, and asking a client the significant question, "whether he is buying or selling" the sample which he brings for analysis. We shall be glad to hear the opinions of our readers on this important subject.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 3, 1873.

This number contains the following original papers and essays relating to chemistry:—

Some Phosphuretted Combinations of Zinc and Cadmium.—B. Renault.—In the introduction to this paper the author gives a brief *resumé* of his former researches on this subject (*Ann de Chimie et de Phys.*, 4th series, vol. ix.). The contents of this paper record more particularly the researches on the phosphurets of cadmium, of which two are mentioned, viz., Cd_3Ph, a metallic-looking substance, soluble in dilute acids, and giving off phosphuretted hydrogen, detonates when struck by a hammer and mixed with oxidising substances. CdPh, a carmine-red coloured, silky-looking substance, which also yields phosphuretted hydrogen when treated with dilute acids. The chemical and physical properties of the phosphurets of cadmium are similar to those of the corresponding zinc compounds.

Synthesis of Organic Substances which have the Property of Optical Rotation. Production of Levo- and Dextro-Rotating Tartaric Acids by Starting with Olefiant Gas.—E. Jungfleisch.—This lengthy essay treats on a somewhat complicated method of converting first, olefiant gas into succinic acid and this, next, into tartaric and racemic acids. It appears that these acids thus artificially obtained are in every respect identical with the same bodies as are naturally formed. It also appears that the optical power of rotation can be produced without the intervention of life.

Description of a Meteoric Stone which fell in Southern Africa in 1862.—Observations on Enstatite or Chaldnite—L. Smith.—A great portion of this paper is devoted to the account of the finding of this stone, and its being ultimately placed in the museum at Cape Town. The sp. gr. of this mineral is 7·692; composition in 100 parts:—Iron, 88·83; nickel, 10·14; cobalt, 0·53; copper, a trace; phosphorus, 0·28. Enstatite, one of the lithoid components of meteoric stones, has the formula—$\dot{R}\ddot{Si},\dot{Mg}\ddot{Si}$; bronzite, $\dot{R}\ddot{Si}(\dot{Mg}\dot{Fe})\ddot{Si}$; olivine $\dot{R}_2\ddot{Si}(\dot{Mg}\dot{Fe}(_2\ddot{Si}$.

Journal für Praktische Chemie, Nos. 17 and 18 (double number), 1872.

This number contains the following original papers and memoirs:—

On Coal-Tar Pitch.—Dr. E. A. Behrens.—The continuation and end of a lengthy essay on this subject.

Technico-Chemical Gas Analysis.—Dr. C. Winkler.—This monograph, illustrated by woodcuts exhibiting apparatus devised by the author, is divided into the following sections:—Aqueous vapour, carbonic acid; nitrogen, sulphurous acid, oxygen, nitric oxide, and nitrous acid; chlorine; hydrochloric acid; ammonia; sulphuretted hydrogen; oxide of carbon.

Dextrine.—C. Barford.—The main gist of this essay may be summarised as follows:—The purity of dextrine; its freedom from grape sugar, can be tested by means of acetate of copper; pure dextrine can ferment when yeast is added to a solution of it, but the fermentation is slow; only carbonic acid is given off; the dextrine is not first converted into grape sugar.

On Molybdate of Ammonia.—L. Kaemmerer.—This paper treats chiefly on a salt spontaneously formed in a solution of ammoniacal molybdate, which had been used in the estimation of phosphoric acid. The percentical composition of the salt alluded to is:—Molybdic acid, 86·211; ammonia, 10 376; water, 3·357; formula, $NH_4O,_3MoO_3+HO$.

Nature of the Gas used for Inhalation (Medicinally) in the Inselbad at Paderborn, Westphalia.—Dr. E. v. Meyer.—A series of tables exhibiting the composition of gases evolved from certain natural springs, and collected in gas-holders for medical use.

Some of the Nitrogen Compounds of Anthrachinon.—R. Boettger and Th. Petersen.—The second instalment of a lengthy essay on this subject, divided into the following sections:—α-mononitro-anthrachinon, $C_{14}H_7(NO_2)O_2$. α-monoamido-anthrachinon, $C_{14}H_7(NH_2)O_2$; α-diazo-anthrachinon-nitrate, $C_{14}H_7N_2O_2.NO_3$; behaviour of α-mononitro-anthrachinon with concentrated sulphuric acid.

Cause of the Coagulation of Milk Casein by Rennet, ~~a~~ and on the So-Called Amphoterous Reaction.—W. Heintz.

Formation of Metanitro-Benzoic Acid during the Nitration of Benzoic Acid.—P. Griess.—This paper treats on the method of separating metanitro-benzoic acid from nitro-benzoic acid.

Researches on the Gases Occluded in Saar Coals.—Dr. E. v. Meyer.—This paper, chiefly a collection of tables exhibiting results of analysis, records researches on the gases occluded in the coals from Saarbrücken district, and on the composition of the air in the pits.

Bayerisches Industrie und Gewerbe-Blatt, January, 1873.

This number does not contain any original papers relating to chemistry.

Polytechnisches Journal von Dr. E. M. Dingler, second number for January, 1873.

Estimation of the Alkali Contained in Beet-Root Juice.—J. Vivien.—Illustrated by woodcuts.

Simplified Apparatus for the Estimation of the Value of Raw Sugar.—Dr. Schiebler.

Indelible Ink.—Dr. Bœttger.—3·65 grms. of aniline black are rubbed down in a porcelain mortar with 60 drops of concentrated hydrochloric acid, and 22 grms. of alcohol. This solution is mixed with a hot solution of 1·82 grms. of gum-arabic in 85 grms. of hot water. This ink does not attack steel pens, and is not acted upon either by strong mineral acids or by alkalies. If the aniline black solution is diluted with shellac solution (21 grms. in 85 of alcohol), an aniline black lake is obtained, which is suited for colouring wood and leather.

Bulletin de la Société Chimique de Paris, February 5, 1873.

This number contains the following original papers and memoirs:—

On some Reactions of Pyruvic Acid.—P. de Clermont.—After briefly referring to the labours of Wislicenus and others on this subject, the author treats on dibromopyruvic acid obtained by the action of chlorine upon dibromolactic acid. The first-named acid is a solid crystalline body, fusion-point 93°, formula $C_3H_2Br_2O_3$; its formation is elucidated by the following formula:—

$$\underbrace{C_3H_4Br_2O_3}_{\text{Dibromolactic Acid.}} + Cl_2 = \underbrace{C_3H_2Br_2O_3}_{\text{Dibromopyruvic Acid.}} + 2HCl.$$

When pyruvic acid is treated with hydrochloric acid at 100 under pressure (sealed tube), the result is the formation of pyrotartaric acid; which, however, exhibits in this instance a somewhat higher fusion-point, viz., 112°. When sulphopyruvic acid and sulphopyruvate of baryta are treated at 100° with an aqueous solution of bromine (under pressure), there is formed a bromated sulphopyruvic acid, a liquid, and a crystalline bromated sulphopyruvate of baryta.

Preparation of Propylenic and Butylenic Bromides.—L. Prunier.—This essay treats exhaustively on the method of preparing the above-mentioned compounds, which are best obtained in crude state by first dissociating, by means of red heat, the vapours of the petroleum oils, boiling at from 60° to 90°. The fluids thus obtained are then submitted to fractional distillation, and lastly bromated. The petroleum oils alluded to yield ethylen, propylen, and butylen.

Bibliograpy.—Under this heading we notice the following works:—"Leçons de Chimie Elémentaire Appliquée aux Arts Industriels, par M. J. Girardin Recteur de l'Académie de Clermont, &c. Cinquiéme édition entièrement refondue, avec figures dans le texte: 5 vols. in 8vo. Three of these are published, and each volume may be had separately. This work is one of the best of the kind ever published, and contains very valuable historical notices. "Leçons de Chimie Agricole, études sur l'Atmosphère, le Sol, et les Engrais," par A. Bobierre, Professeur de Chimie à Nantes. "Simples Notions sur l'achat et l'emploi de Engrais Commerciaux," par A. Bobierre. These works are highly spoken of, and are recommended to all interested in agricultural science. The above works are all published by G. Masson, Paris.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 2, 1873.

This number contains nothing relating to chemistry, but we call attention to the two following papers:—

Improved Steam-Boiler Provided with a Double Water Compartment (à Double Nappe d'eau).—M. Felix.—The description of a high-pressure steam boiler devised for the prevention of boiler incrustation, as well as deficiency of water.

Atmospheric Coal-Winding Machine.—Z. Blauchet.—The last part of a detailed account of a mechanism contrived to supersede the ordinary methods used for bringing to bank the coal wrought in pits. We learn from the statistics here given, that this atmospheric system saves a great deal of labour, and is far more effectual than the plans now in use.

Les Mondes, February 6, 1873.

No original matter relating to chemistry is contained in this number, but we call attention to the paper on—

The Dry Fog (Callina of the Spainards; Hohenrauch or Haarruch of the Germans).—M. Collas.—This essay treats on a phenomenon known in Holland as "veendamp," a peculiar kind of fog; the cause of which, in North Western Germany, Holland, and adjacent countries, is in part due at least to the burning of peat-bog soil in early spring for the purpose of preparing the soil for buckwheat sowing; but in Spain, Mexico, and other countries, the author states that this fog is caused by cosmical influences.

The Flints of the Meudon Chalk and Boulder Stones with Impressions.—M. Choyer.—A geologico-geognostical essay.

Artificially made Stone.—L. Mignot.—This exhaustive paper is mainly published to prove that the author is the first who, by dissolving flints in caustic alkali, has applied this solution to the preparation of various kinds of artificial stones and other building materials. Among the preparations mentioned he quotes ceramic glue, which when applied to glass and dried adheres so tenaciously that the glass scales off when the glue is attempted to be removed.

Obituary.—Under this heading we are informed of the death of M. Clerget, who for many years held the position of scientific adviser to the Administration des Douanes in France, and who introduced the optical saccharometer (Soleil's) for the purpose of ascertaining the value of raw sugar.

La Revue Scientifique de la France et de l'Etranger, February 1, 1873.

The only paper bearing upon chemistry is:—

On the Cost of Manure, and on the Condition of Agricultural Property in France.—G. Ville.—A valuable paper on practical agriculture.

Le Moniteur Scientifique Quesneville, February, 1873.

This number contains the following original papers and memoirs relating to chemistry:—

Present Condition of Agricultural Science in France, and other Countries.—L. Mussa.—The first instalment of an agronomical monograph. This portion treats on phytophysiology.

Presence of Silver in Subnitrate of Bismuth.—Ch. Ekin.—After observing that the preparation alluded to often contains silver, of which, however, no notice is taken in most works on pharmacy, the author states that having tested many samples for the purpose of detecting the presence of a silver compound (subchloride), he found some samples of the subnitrate (basic nitrate, bismuthum-hydiconitricum) to contain from 3·9 to 6·5 per cent of subchloride of silver; and in other samples he found some metallic silver in a finely divided state, but in a small quantity. It appears that these impurities are for the most part due to an imperfect method of preparing the subnitrate of bismuth. It is well known that metallic bismuth often contains silver.

MEETINGS FOR THE WEEK.

Monday, Feb. 17th.—Medical, 8.
— London Institution, 4.
Tuesday, 18th.—Civil Engineers, 8.
— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
— Anthropological, 8.
— Zoological, 8½.
Wednesday, 19th.—Society of Arts, 8.
— Meteorological, 7.
Thursday, 20th.—Royal, 8½.
— Royal Society Club, 6.
— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
— Zoological, 4.
— Chemical, 8. R. S. Dale and Dr. C. Schorlemmer, "On Aurine." Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies: I. On Iodide of Ethyl." Mr. Wills, "Solidification of Nitrous Oxide." Dr. C. R. A. Wright, "Action of Hydrochloric Acid on Codeine."
Friday, 21st.—Geological, 1. (Anniversary.)
— Royal Institution, 9. Prof. Clerk Maxwell, "On Action at a Distance."
Saturday, 22nd.—Royal Institution, 3. Dr. Edward A. Freeman, D.C.L., "On Comparative Politics."

THE CHEMICAL NEWS.

VOL. XXVII. No. 691.

ON A
NEW RELATION BETWEEN HEAT AND ELECTRICITY.*

By FREDERICK GUTHRIE.

IT is found that the reaction between an electrified body and a neighbouring neutral one, whereby the electricity in the neutral body is inductively decomposed and attraction produced, undergoes a modification when the neutral body is considerably heated.

Under many circumstances it is found that the electrified body is rapidly and completely discharged. The action of discharge is shown to depend mainly upon the following conditions :—(1). The temperature of the discharging body, and its distance from the electrified one. (2). The nature (+ or −) of the latter's electricity.

With regard to (1), it is shown that the discharging power of a hot body diminishes with its distance and increases with its temperature. But, concerning the temperature, it is proved that the discharging power of a hot body does not depend upon the quantity of heat radiated from it to the electrified body, but chiefly upon its quality. Thus a white-hot platinum wire connected with the earth may exercise an indefinitely greater discharging power, at the same distance, than a large mass of iron at 100° C., though the latter may impart more heat to the electrified body.

Neither the mere reception of heat, however intense, by the electrified body, unless the latter have such small capacity as to be itself intensely heated, discharges the electricity if the source of heat be distant, nor is discharge effected when the electrified body and a neighbouring cold one are surrounded by air through which intense heat is passing; but, for the discharge, it is necessary that heat of intensity pass to the electrified body from a neutral body within inductive range.

White- and red-hot metallic neutral bodies exercise this discharging power even when isolated from the earth, but always with less facility than when earth-connected.

The hotter the discharging body, whether isolated or earth-connected, the more nearly alike do + or − electricities behave in being discharged; but at certain temperatures distinct differences are noticed. The − electricity, in all cases of difference, is discharged with greater facility than the +.

Attempts are made to measure the critical temperatures at which earth-connected hot iron (1) discharges + and − electricity with nearly the same facility, (2) begins, as it cools, to show a preferential power of discharging −, and (3) ceases to discharge −. The temperatures so obtained are measured by the number of heat-units, measured from 0° C. in 1 grm. of iron of the respective temperature, represented by the value of the expression $Fe\Sigma_0^t u$.

It is shown that various flames, both earth-connected and isolated, have an exceedingly great power of discharging both kinds of electricity.

The effects in regard to discharge are shown to be similar when platinum-wire, rendered hot by a galvanic current, is used, and also when the condensed electricity of a Leyden jar is experimented on.

As hot iron shows a preferential power of discharging − over + electricity, so it is found that white-hot, but isolated, iron refuses to be charged either with + or − electricity. As the iron cools, it acquires first the power of receiving −, and afterwards of receiving +. Further, while white-hot iron in contact with an electrified body prevents that body from retaining a charge of either kind of electricity, as it cools it permits a + charge to be received, and subsequently a − one.

A suggestion is made as to the existence of an electrical coercitive force, the presence of which, together with its diminution by heat, would explain much of what has been described.

* Abstract of a Paper read before the Royal Society.

QUANTITATIVE ESTIMATION OF MANGANESE IN IRON ORES, PIG-IRON, AND STEEL,

BY MEANS OF A
COLORIMETRIC PROCESS.

By P. PICHARD.

I WEIGH off 0·1 grm. of pig-iron, cast-iron, or steel which has previously been very finely pulverised; the substance is strongly ignited in a small porcelain or platinum crucible, so as to effect a roasting as well as oxidation. After cooling, it is carefully and intimately mixed with from 2 to 3 decigrms. of previously ignited dry carbonate of soda, and then again ignited at a very high temperature. I add to the cooled, fused, or sintered mass 5 c.c. of concentrated nitric acid and one drop of hydrochloric acid; the iron and manganese become dissolved after a few hours, an operation which may be greatly assisted by placing the crucible in a warm situation. As soon as no matter is adhering to the sides of the crucible, its contents are poured into a glass tube, 20 centims. in length and from 15 to 18 m.m. in diameter, and closed at one end; the crucible is well washed with boiling water. The tube and contents are heated to boiling over a spirit-lamp, so as entirely to dissolve all the manganese; when this has been effected, 10 c.c. of water are again added, and then half a grm. of peroxide of lead. The tube is then heated again, and its contents kept boiling for two or three minutes. The excess of peroxide of lead having settled, the clear liquid is decanted and poured into a graduated tube of 500 c.c. cubic capacity. The peroxide of lead left in the test-tube is washed with a mixture consisting of 1 c.c. of nitric acid and 5 c.c. of distilled water; if this should not yield a nearly colourless solution, the washing is repeated, and aided by boiling. The wash-waters are added to the solution first obtained, and the fluid contained in the graduated tube is thoroughly mixed by shaking the tube gently. This having been done, a standard solution of manganese, by treating, in the manner described, 7 milligrms. of the red oxide of that metal, a quantity corresponding to 5 milligrms. of manganese. The solution of permanganate of soda thus obtained is poured into a graduated tube of 500 c.c. capacity, and the fluid contained therein is diluted with water until the hue of the liquid corresponds exactly to that of the iron or other substance under trial. In order to judge distinctly of the colour, the tubes are held next to each other, and a sheet of white paper close to them. The number of divisions of the tubes occupied by fluid having been read off, the quantity of manganese sought for is found by the use of the following equation :—

$$\frac{x}{5} = \frac{V}{V'}, \quad x = \frac{5V}{Vt}$$

x being the unknown quantity, and V the volume corresponding thereto; Vt the volume of the standard solution corresponding to 5 milligrms. of manganese. The quantity of manganese is found in centièmes (hundredths). As in many manganiferous iron ores the proportion of manganese present rarely exceeds 5 per cent, and is seldom even so high in cast-iron, pig-iron, or steel, calculation can be dispensed with by at once diluting the standard solution to 500 c.c. (the colour is even then very marked). The liquid to be tested is then diluted until the colour is

precisely the same; by reading off the number of divisions occupied by the liquid, the percentage of manganese is at once found. Since 500 c.c. of the standard solution correspond to 5 milligrms. of manganese, 1 c.c. corresponds to 0·00001 grm., say, for 0·1 grm. of mineral weighed off $= \frac{1}{10,000}$ of the total weight. If the volume of the liquid is 275 c.c., the proportion of manganese will be $\frac{275}{10,000} = 2·75$ per cent. With a practised eye, it is not difficult to distinguish the hues of the liquors, even at that great degree of dilution, and the estimation of the manganese may be made to within $\frac{1}{10,000}$; at first, the estimation may even be made to within $\frac{1}{1000}$. If it should happen that at a first assay the proportion of manganese is found below $\frac{1}{1000}$, it is best to take larger quantities of material, say 3, 4, or 5 decigrms.; the quantity of carbonate of soda is, of course, proportionately increased, and the operation carried on as described above—the final result being divided by 3, 4, or 5. The standard solution may be kept for some days in a well-stoppered bottle, but gradually sesquioxide of manganese is deposited, and when this is the case the solution must be made afresh.—*Comptes Rendus.*

PROPOSED SUBSTITUTE FOR COAL-GAS.

We have recently had an opportunity of inspecting, in company with some sixty gentlemen interested in gas manufacture, the new process which is now being advertised so largely by a company which bears the title of "The New Gas Company, Limited." The works are on the premises of the Southwark and Vauxhall Water Company, at Battersea, and are well adapted for experiments upon a somewhat large scale.

The new Company proposes to purchase the patents of Mr. W. D. Ruck, which appear to have culminated in the process we are about to describe. Everything was explained to us with great courtesy, and although there were some points of imperfection in the experiments we witnessed, the trial was upon the whole a fair one as far as it went.

The apparatus consists of three iron gas retorts set in a single furnace, one over the other two. Close above the retorts, and heated to bright redness by the same fire, is a horizontal U-shaped iron pipe about 4 inches in diameter. The retorts are charged with a mixture of coke and iron, and steam from an ordinary boiler is then forced through the iron pipe, which it is obvious acts as a superheater. The superheated steam passes into the two lower retorts, being carried by pipes arranged in their axes to the further end, and then returning through the mass of heated coke and iron. It then traverses the third retort in the same manner, and in this way a large volume of gas is generated, which is cooled in a temporary condenser and carried to a gas-holder. It is then purified in the ordinary way.

The gas so obtained has of course no illuminating, though a very considerable heating value. It is, in fact, a mixture of hydrogen, carbonic oxide, and carbonic acid, the latter amounting, it is said, to about 12 per cent. To render it luminiferous, it is passed through a chamber containing rectified petroleum spirit of sp. gr. 0·68. Of course a considerable quantity of the vapour of this spirit is taken up, and the volume of the gas is increased, it is said, by about 25 per cent. The gas then burns with a brilliant flame, and is ready for distribution.

In regard to the merits of this scheme, it must be remarked, in the first place, that it does not present any points of absolute novelty. The decomposition of steam by red-hot carbon was correctly described by Clement and Desormes in 1809, and is familiar to all chemists. In 1839, Bunsen published an analysis of the gases produced; they consisted, in round numbers, under the circumstances of his experiment, of—Hydrogen, 56; carbonic oxide, 29; and carbonic acid, 15. The process, in one form or other, has been the subject of numerous patents. The reaction can be explained by one of two formulæ, according as carbonic oxide or carbonic acid is produced:—

(1). $H_2O+C=H_2+CO.$

(2). $2H_2O+C=2H_2+CO_2.$

In (1) the volumes of hydrogen and carbonic oxide formed are equal, and 1 ton of pure carbon should yield 2·5 tons of the mixed gases, they jointly having a sp. gr. of 0·519 (at standard pressure and temperature) and a volume of 133,659 cubic feet. If reaction (2) took place alone, two volumes of hydrogen to one of carbonic acid would be obtained. One ton of pure carbon would then yield 4 tons of the mixed gases, they having a sp. gr. of 0·554 and a total volume of 200,337 cubic feet. The volume obtained in either case would, of course, be somewhat greater at the ordinary temperature of the air. In practice, the two reactions take place, as chemical reactions so often do, side by side. The gas obtained by Bunsen must, at standard pressure and temperature, have possessed a sp. gr. of about 0·548.

The carburetting process is scarcely more novel. Of late years, methods for increasing the illuminating power of gas, by introducing the vapour of hydrocarbons, have been tried again and again, and a flourishing rival to the new Company is now trying to introduce the use of a gas made by passing common air through a similar petroleum spirit.

It must not be supposed, from the foregoing remarks, that we intend to assert the invalidity of Mr. Ruck's patents. We do not pretend to form any opinion upon this point. It often happens that a patent is perfectly sound, even when it embodies no original idea, some modification in the physical conditions constituting in the eye of the law a sufficient novelty to justify protection. Indeed, some such modification is often all that is necessary to convert a worthless into a highly valuable process. This was the case notoriously with the celebrated paraffin oil patent.

One of the gravest questions in regard to the new gas is whether and how far its illuminating power will stand the test of cold. The vapour introduced is, after all, a vapour, and as such capable of more or less complete condensation. Would any such condensation occur during cold weather, and if so, would its amount be sufficient to impair in any serious degree the value of the gas? It is well known that many carburetting schemes have failed from this cause, and although it may be that so light a spirit has not been employed before, the point is one that ought to be most clearly made out. The scientific advisers of the new Company assure us that they have tried the experiment of cooling, and also of storing the gas, without injuring its quality, but we confess we should like more complete and definite evidence in support of their assertion. The day upon which we saw the experiment was a very cold one, and more than 1000 yards of 3-inch main, all ready fitted, lay outside the building, having, we were told, been previously used for just such a trial. Why was not the gas passed through it? The experiment would have been peculiarly convincing on such a cold day, especially if the gas had been suffered to remain for four-and-twenty hours in the main.

The question whether or not the vapour will condense in material quantity in cold weather could only be answered by a knowledge of its tension at low temperatures. Upon this point we have no evidence before us, and are therefore unable to express an opinion.

Some doubt also hangs over another matter. The printed reports of the Company assert the superiority of its gas over the air-gas, because the latter, having about the same specific gravity as air, requires so much force to drive it through the pipes. And yet they do not tell us

the specific gravity of their own. If it be true that it contains 20 per cent of the vapour of liquid hydrocarbons, it is difficult to understand how the sp. gr. can be much less than that of common air. Hexane, for instance, C_6H_{14}, one of the largest constituents of petroleum spirit, has, at standard pressure and temperature, a vapour density very nearly three times that of the atmosphere.

The new process claims to effect a great saving in regard to expense. One ton of coal by the old process yields, in round numbers, 10,000 cubic feet of gas; whereas by the new, one ton of coke should yield from 130,000 to 150,000 cubic feet, or possibly even more. The result is stated in the prospectus to be that the labour of twenty-nine out of every thirty men will be saved. In another part of the same prospectus, we are, however, told that the saving of labour will be "to the extent of 50 per cent," so that there appears some ambiguity in the matter. Messrs. Quick and Son, the engineers, report, as the result of their experiments and calculations, that "gas of 16½ candle-power may be manufactured at a cost of 1s. 7¾d. per thousand cubic feet." Such a consummation is devoutly to be wished, but its realisation must obviously depend upon a somewhat complex set of conditions. The managers of the undertaking do not hope, we understand, to get their processes adopted in large English towns, for the present at any rate. Probably they are wise, for if they did they would at once be met with the difficulty,—Where is the necessary coke to come from if the old mode of gas-making be abandoned? Charcoal, or even wood, would hardly be proposed as a substitute in this country. In many foreign countries the case is very different, and it certainly appears possible, or even perhaps probable, that in places where wood is cheap and coal very dear, this process, or some slight modification of it, may be adopted with advantage.

One of our contemporaries, animadverting somewhat severely upon the new process, exclaims against the idea of introducing so deadly a poison as carbonic oxide into our houses. The point is one of great importance. It is true that ordinary coal-gas contains this poison to the extent of some 5 or 6 per cent. It is also true that carbonic oxide is completely converted into the comparatively harmless carbonic acid when burnt, but there is some difference after all between 5 or 6 per cent and 29, and the risk of an escape of gas would be materially increased by the presence in it of so large a quantity of such a deadly ingredient.

Here, again, we require more information, but we must admit that we hardly think it likely that the terrific results dreaded by our contemporary would be verified even if the new gas were introduced. Surely it is an exaggeration to say that "an escape of this gas, such as takes place in many houses every day with coal-gas, would be certain death to every one of the inhabitants."

In conclusion, we will remark that, although it has been our duty to present to our readers the chief doubts that beset us in regard to the new scheme, we are far from thinking it absurd or unworthy of trial; on the contrary, we would fain hope that under certain circumstances it may prove a valuable addition to our means of comfort.

PYROLOGY, OR FIRE ANALYSIS.*

By Captain W. A. ROSS, R.A.

(Concluded from p. 81).

Boric Acid (Symbol Ƀ).

58. Plattner and succeeding writers on the "blowpipe" made use of this substance for the purpose of separating metallic lead from copper, in an alloy of the two, by oxidising the former, and therefore as a means of *affinage* of the latter metal.† In this operation, Ƀ appears to absorb litharge precisely as bone-ash does in cupellation; but it acts at the same time as a kind of shield to protect the copper from oxidation.

59. Berzelius employed Ƀ as a test of phosphoric acid in phosphates by the insertion through the mass of a piece of pure iron wire, which is corroded and fused if the phosphoric acid exists over 5 per cent; but this reaction, to be effectual, presupposes the perfect solution of the substance containing the phosphate in Ƀ, which, as will be seen, can be effected with very few oxides indeed.

60. In fact it is precisely the insolubility of almost all substances but the alkalies in boric acid which gives it the extraordinary value it undoubtedly possesses as an agent of *separation;* and the following few examples will not only clearly demonstrate this fact to the impartial chemist, but show him that the fact itself has been utterly passed over by writers on the subject hitherto, and that the real analytical value of Ƀ, therefore, has remained unknown.

Oxides of Cerium, Didymium, and Lanthanum.

61. If a good specimen of the mineral "cerite" be powdered and applied to a bead of Ƀ in an O. P., the following phenomenon results. The substance appears to separate into three distinct parts:—(1) red-brown and resinous-looking round spots appear near, but not *on* the surface; (2) other round spots, more bulky or puffed out, nearer the middle of the bead, of a pale buff colour; (3) a slight milky turbidity through the bead, as though a finely divided precipitate were suspended throughout the whole mass. If what is sold or made by the chemists as "pure oxide of cerium" (generally a nut-brown powder) be applied to a Ƀ bead in like manner, precisely the same triplicate separation occurs, only the turbidity is very much less.

62. These round spots are observed to be round through a lens when viewed in *every* direction; they are therefore sphericles or globules.* After considerably long treatment with O. P. the smaller buff-coloured globules will be dissipated throughout the bead, causing more turbidity with a slight shade of buff in it; but the red resinous globules remain unchanged, appearing white-hot in the red-hot bead (from which it appears that their fusing-point is higher than that of Ƀ), and may be collected, from their superior specific gravity, at the bottom of the bead, by careful manipulation with the point of the blue pyrocone, into one large globule.

63. Professor Stokes has found that, by treating this Ƀ bead with distilled water, the general mass is dissolved, while the contained globules remain intact, the most minute of which may be thus perfectly extracted. They may be also extracted more quickly, but with less precision, by wrapping the bead when *quite* cold in paper, and tapping it gently upon an anvil with a light hammer, when the matrix breaks away from the globules. Added to a bead of Ᵽ under O. P., the red globule first fuses to an intensely lemon-coloured mass on the surface, and then dissolves in the glass with effervescence, giving the reactions of ceric oxide. These red ceric globules have been discovered by Professor Stokes to contain also oxide of *didymium*, the absorption-bands of which, when spectroscopically examined, they show very distinctly.

64. It is therefore assumed that the red balls are composed of ceric + didymic oxides, and the buff-coloured ones of lanthanic oxide; while the turbidity is proved beyond reasonable doubt to be caused by lime, which with baryta are the only substances, except phosphoric acid, capable of causing this opaline turbidity on *first* application to the Ƀ bead.† At any rate, the so-called "pure oxide of cerium" is thus shown, by one simple operation, to consist in reality of no less than *four* substances.

* Communicated by the Author. From the *Proceedings of the Royal Society*.

† *Vide* Plattner's "Probirkunst" &c., edition of 1865.

* This was written before the writer knew how to extract these globules: *vide* next paragraph.

† A trace of phosphoric acid applied to a bead of boric acid, and heated in O. P., affords a glass when cool having an almost perfect resemblance to an opal.

Lime, Strontia, Baryta, Alumina, Silica, and Magnesia.

65. Of the alkaline earths, lime, as above mentioned, causes immediate turbidity over the whole bead, and when added in greater proportion produces round spots suspended in the turbid mass. These spots are perfectly clear and colourless, like drops of limpid oil in milk. When added in very large proportion, the clear spots collect in one large one, which, if still further addition of lime is made, absorbs the remainder of the turbid part, leaving the whole bead beautifully clear and colourless. The turbid part, therefore, would appear to be an attempted solution of the lime by the boric acid; the clear part, a complete solution of the boric acid in the borate of lime.

66. Strontia forms large, beautiful, vitreous-looking globules, quite transparent and even refractive; they have great specific gravity, and can be easily aggregated at the bottom of the bead. Baryta affords sphericles like fish-eyes, transparent at first, but soon becoming opaque. Magnesia is not at first acted on by B, but after a short O. P. resolves itself into opaque, white, and compact sphericles, like miniature snow-balls; these, after long O. P., and consequent exhaustion of B, are clarified and become transparent, but are again rendered opaque by the addition of fresh B. It is concluded from this fact that these contained balls have a fixed relative proportion as regards quantity to the containing B. Alumina and silica remain as amorphous fragments, and do not congest into globules: those of the former are white and opaque, like pieces of fat; of the latter, semi-transparent.

The Alkalies.

67. Soda, potash, and lithia, appear to be the only substances which dissolve completely in boric acid in any proportion, and hence the value of the latter as a detective agent for them, and also as an alkalimeter; for if a very small trace of soda or potash contained in a mineral or salt be applied to a B bead having globules of cobalt (for instance) suspended in it, those nearest the side where the alkali is applied are dispersed and spread over that side as a pink suffusion. If 5 per cent be added, the sphericles of cobalt disappear, the whole bead is clarified, and assumes a blue colour while hot, but remains pink on cooling. If 17 per cent be added, the bead remains *blue* on cooling, and (in the case of soda) borax has been formed; but this method would probably be considered incomplete if it did not afford a means of distinguishing between, as well as of measuring, these two alkalies; and this it does as follows:—

Vesiculation.

68. If the B bead, on the addition to it of the substance to be examined, shows, by the reaction above described, that an alkali is contained in the latter, a fresh bead should be impregnated with a weighed portion of the substance, which should be dissolved as far as possible by an O. P. Then, the bead being rapidly removed from the point of the pyrocone, it should be blown into while red-hot with the jet of the pyrogene, which for that purpose should be advanced so as just to touch the ring of the platinum-wire. If the bead be not too cold, the result will be that the whole mass is blown out into a thin clear bubble or vesicle, about seventy times its first size, thus presenting a very large surface of the dissolved substance to be operated on. This vesicle should then be held in the operator's open mouth, and breathed upon for some time, when, if the alkali has contained even a trace of potash (1 per cent of KO affords the reaction), the vesicle will immediately become clouded over with a light blue film of the colour of a solution of quinine when held against the light. If only soda be present the vesicle will remain clear, but will begin to deliquesce. Lithia affords a tarnish like that of breath on a pane of glass, and the vesicle does *not* deliquesce.

69. This test for potash in presence of soda is so delicate that if two beads, even of borax, one containing a trace of potash, be vesiculated, and allowed to remain in a moderately dry room for some time, the one containing the potash will in the course of a few hours cloud over, while the other will remain quite clear.

Determination of Gases by Vesiculation.

70. The B vesicle by itself will cloud over after a few minutes, but the appearance then is more white than blue; and if the clouded vesicle be approached to the flame of a spirit-lamp, this white coating is not removed until the flame almost touches it and shrivels the substance of the vesicle, whereas in the case of the addition of a trace of potash, the cloud flies as if by magic when the vesicle is even a considerable distance off.

71. The addition of *chlorine* to the B bead, made by dipping the bead in strong hydrochloric acid and treating as in paragraph 48, apparently causes the vesicle made therefrom to be still more sensitive to the action of gases upon its surface. It clouds over in common air almost the instant it is made. If held over a solution of *ammonia* this nubilescence is prevented, and the vesicle remains clear. If held in a noxious or putrescent gas, creamy or brownish-white streaks are formed over the surface, which is otherwise clear. But the most characteristic reaction is that afforded by sulphuretted hydrogen, in an atmosphere of which this vesicle becomes rapidly pitted with circular spots, as though it had suddenly taken smallpox. These spots, through a lens, are observed to be round radiated crystals, with a yellowish tinge near the circumference. After a short time they rot into holes.

72. Another curious result of vesiculation is the crystallisation of the surface, in a moderately damp atmosphere, in the course of ten or twelve hours. Borax-vesicles show these best; but the complicated nature of the salts formed renders conclusions from their crystallisation very uncertain. Microscopically viewed, however, these crystals are very beautiful, especially in polarised light; and it seems at any rate certain that silica and the silicates thus treated invariably crystallise in most elegant and beautiful arborescent appearances, the form taken by other salts being usually that of a disk, often of a leaf.

Cobalt, Copper, and Metallic Oxides.

73. The behaviour of these in B has not yet been fully examined, but such as have promise results quite as interesting and important as those which may be derived from that of the earths. For instance, when an ore containing the oxides of cobalt and nickel, previously manipulated as in paragraph 90, is boracically treated as described in par. 61, the cobalt immediately congests into globules, which after O. P. appear blue-black, after H. P. red-purple through a lens; the nickel oxide, on the contrary, remains in amorphous fragments, which are bright green after O. P., and have a metallic lustre after H. P. Cupric oxide forms in O. P. balls of an indigo-blue colour, not easily distinguishable at first from those of cobalt; but in H. P. the cupreous globules immediately give out streaks of the red suboxide, which cannot be mistaken, though, of course, were further proof necessary, the addition of 5 per cent of soda would form a pink glass from the first, and a blue one from the second. Iron oxide remains in amorphous fragments of a black-brown colour with a rusty halo or tinge round them, and is thus easily distinguished. Oxide of uranium forms a stringy black mass with a yellowish opacity round, which the addition of soda dissolves to a bright pea-green bead. Molybdic acid affords many curious and beautiful changes, for a description of which there is not space.

Silver, Lead, and the Volatilisable Oxides.

74. None of these form either balls or fragments in boric acid, but spread over the whole bead as a milky precipitate, that of silver having a slight pinkish tinge. Nothing, therefore, can be easier than their separation thus from those metallic oxides which form balls or fragments, as the former of these can not only be collected or aggregated into one sphericle, but extracted from the cold bead with the greatest ease, as described in paragraph 63.

It is obvious that this process would probably form an important method of extracting *silver* from its ores with very little loss; for the boric acid protects oxides contained in it from the direct effect of an O. P., which dissipates pure silver unprotected to the extent of 10 per cent in a very short time.

75. Altogether, as a detective reagent, boric acid seems scarcely inferior even to phosphoric acid, while as a separating one it is quite unsurpassed. Many hypotheses of the formation of these sphericles or balls have suggested themselves to the writer, but none with a sufficient weight of evidence in their favour to be stated here. They may be due (*a*) to capillary phenomena, (*b*) to the retention of a certain amount of carbonic acid (for of the "earths" it is evidently only those forming carbonates which produce them), or (*c*) to some law or principle as yet not fully known.

76. A bead of pure boric acid is evidently more fluid in H. P. than in O. P., and the hydrated appearance of cobaltine balls in the former (paragraph 73) would seem to suggest the setting free of some constitutional water (?).

Phosphate of Lime.

77. This is a useful flux for purposes of mere solution, as referred to in paragraph 39. A curious phenomenon results from the application to the hot glass, containing a metallic oxide in solution, of carbonate of soda, which, instead of fusing in the glass under O. P., does so by itself at first, apparently drawing or precipitating the metallic oxide to itself. If a hot glass of phosphoric acid be applied to warm calcined lime, the mixture takes fire and burns with a very pretty pale yellow light, phosphate of lime being formed. This flux has been little investigated for pyrological purposes, having been thus first used by the writer.

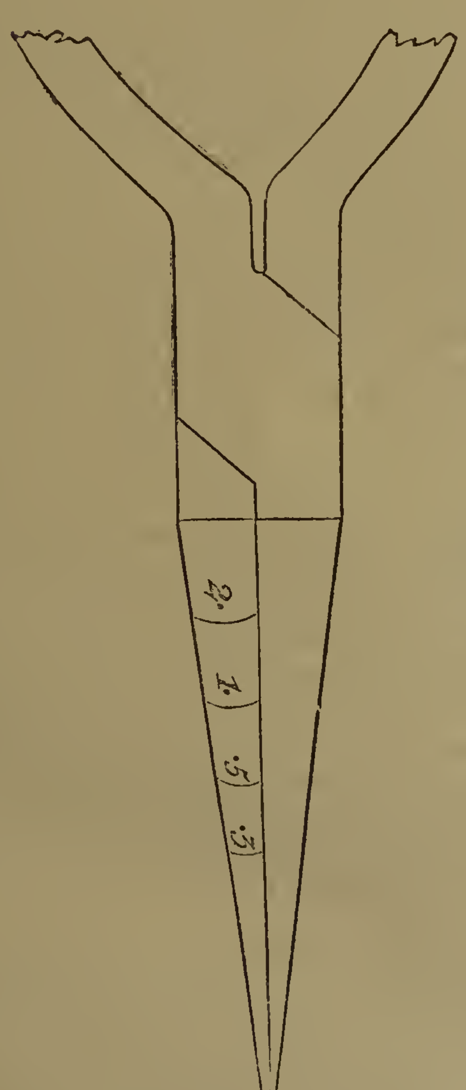


FIG. 6.

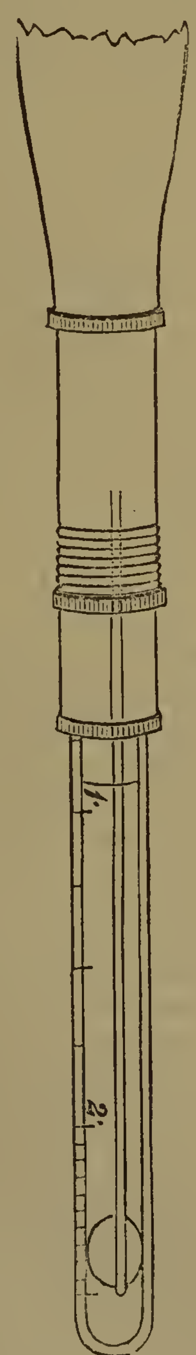


FIG. 5.

Quantitative Analysis by "Glasses" or "Beads."

78. For this purpose it is evident that the glass must not only be weighed, but measured; for, as both phosphoric and boric acids lose weight and substance in direct proportion after a strong O. P., some means of measuring the diameter of the bead, and of thus keeping it up to the mark, is required. Sufficient accuracy for this purpose seems to be afforded by a simple instrument, as that shown in Fig. 5, representing a common glass tube which exactly covers a 50-mgr. bead of phosphoric acid. The graduations on the outside of the tube are for the purpose of showing the length of the platinum-wire (in tenths of an inch), which of course is proportional to its weight, the thickness or diameter being the same.

79. Fig. 6 represents the instrument with which the platinum-wire is twisted into a loop, which must be perfectly circular, and of a diameter corresponding to the size of glass required. It is a pair of common cage-maker's pliers, with round but tapering legs; only the right (or left) leg should be graduated and figured, say, in tenths of an inch, to show the diameter of the loop made on the other one. Neither of these instruments, however, is to be understood as at all dispensing with the use of the assay balance, of which a beautifully portable description is now made cheaply at Freiberg; it indeed is indispensable, and to be referred to when any doubt is entertained.

Roasting through *Platinum-Foil.*

80. The cautions and directions against using the platinum which is supplied as part of all pyrological apparatus, to be found in most chemical works, are manifold and almost amusing. It would be better, if these directions are to be followed, to have no platinum-foil at all

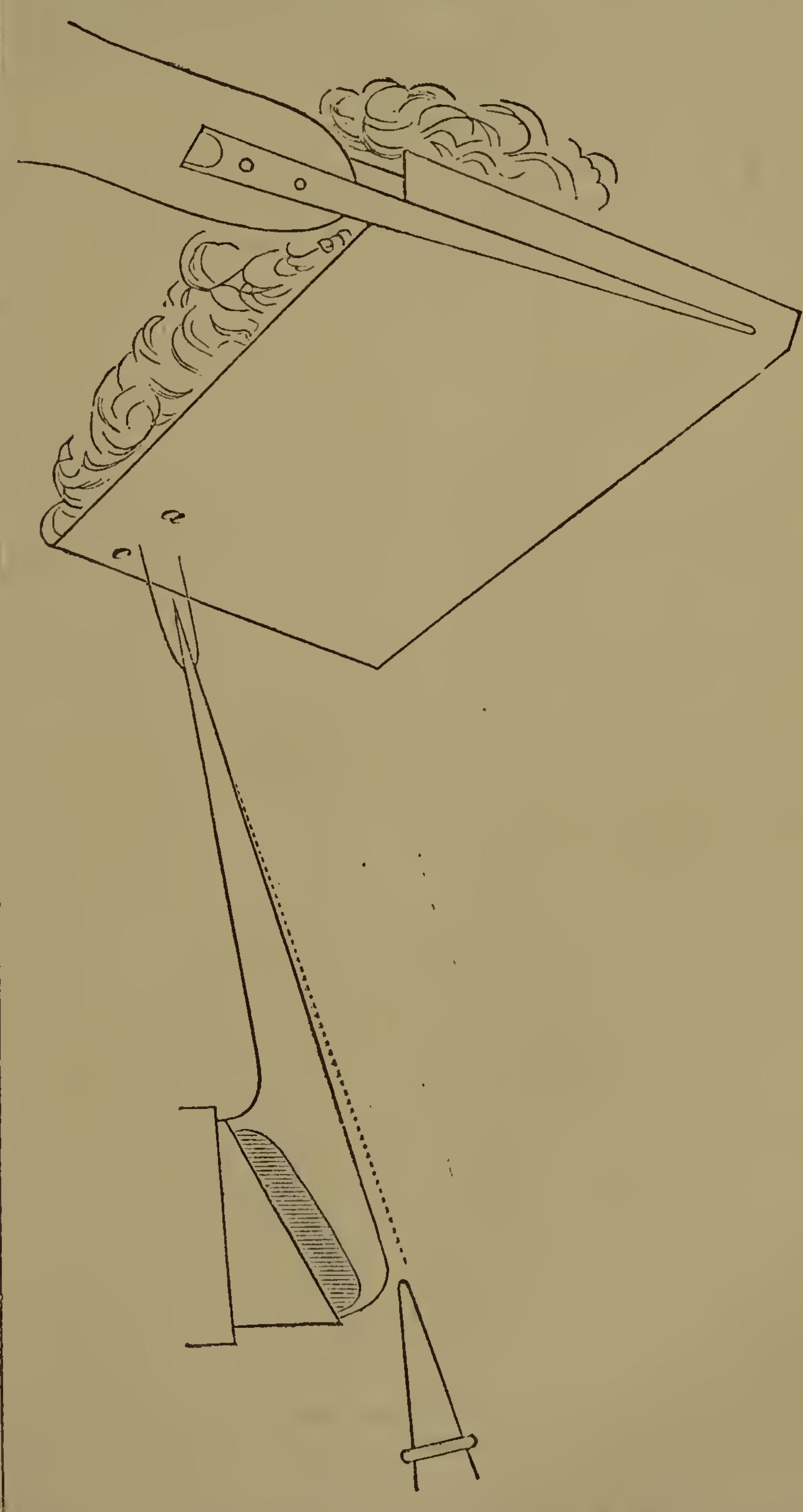


FIG. 7.

than to have it and not use it; but in practice it will be found that there are comparatively few substances which injure platinum-foil when heated *through* it, to such an extent that it cannot be advantageously used for months. The ore called "stibnite" is one of these, but with care even galena may be thus innocuously roasted.

81. The foil, which should be thicker than the usual English kind, can be conveniently made into a small tray about $1 \cdot 5 \times 1$ inch, and held, as in Fig. 7, with a pair of brass pliers having steel legs, the subject of examination being deposited as a paste (made on a slab with distilled water) on its lower lip. The point of the pyrocone must then be applied to the *back* of the tray opposite the substance, and on no account is it to be directed upon its surface.

82. It will be found that only a certain and normal, not an uncertain and irregular, degree of heat *can* thus be applied to substances which under pyrological conditions combine with oxygen or are reduced to the metallic state; and therefore that oxidation on the one hand is as exactly regulated as though it had been controlled by a balance, and that reduction on the other hand need not be feared, except in the case of the very fusible metals, as antimony or lead. For instance, copper pyrites roasted in this way will be found to lose exactly 17 per cent and no more, however long or strongly the pyrocone has been applied.

The same amount of sulphur is thus driven off from "copper glance," and there can therefore be little reasonable doubt that 17 per cent is the extent to which sulphur may be dissipated from copper ores without fusing both together.

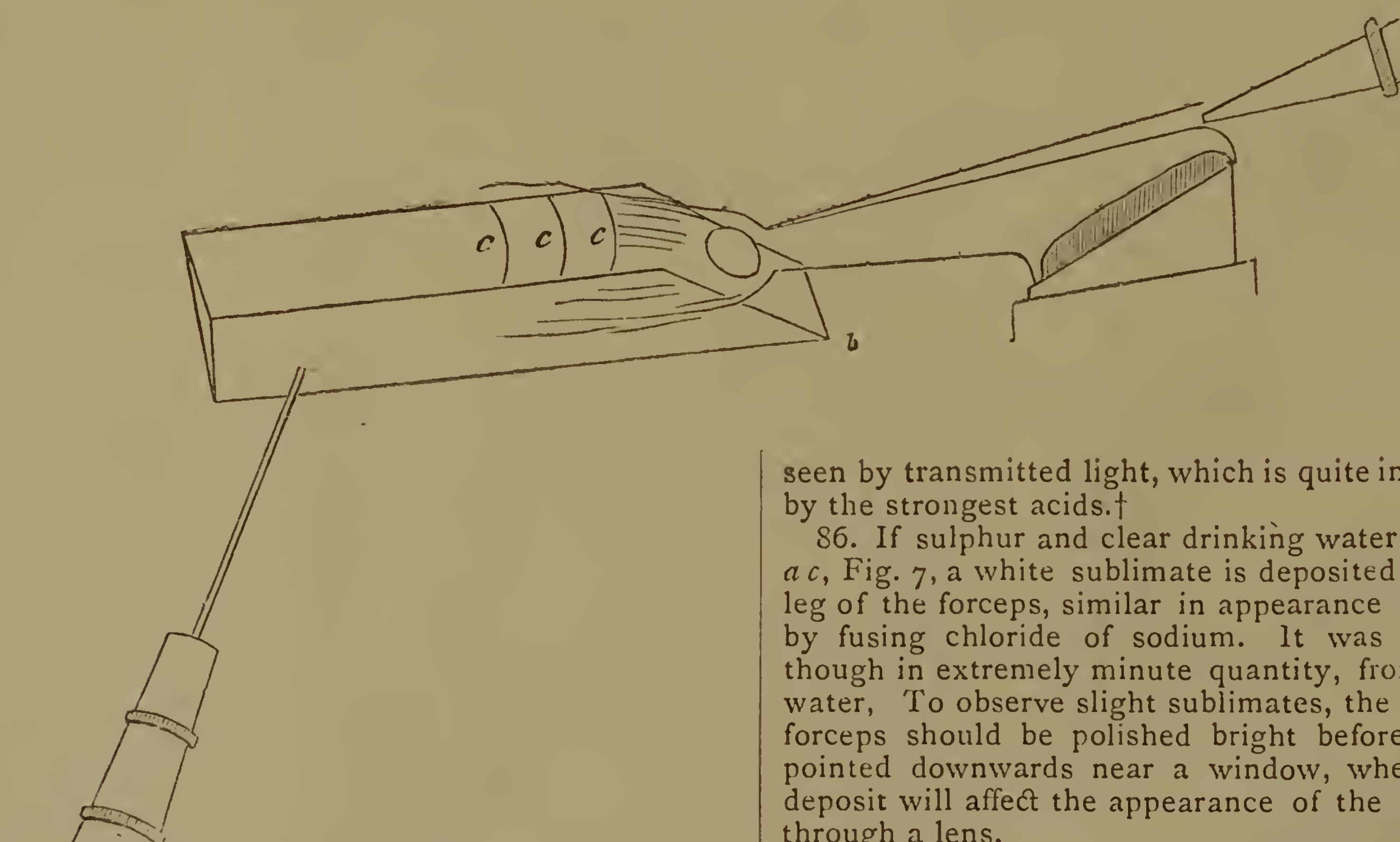
Sublimation.

83. This is better performed on such a platinum tray held by steel-legged forceps than in the ordinary manner on charcoal or in a glass tube. By mixing a little common rust or lime with arsenic or antimony, the most timid operator need not fear injury to his platinum, which, however, it is far better to spoil than to lose a single valuable reaction. The addition of iron sesquioxide has another advantage; for it will be observed that the antimonial oxide mixed with it is deposited on the upper steel leg of the forceps unchanged as a *white* sublimate, but the arsenic oxide as an *orange* one, in consequence, it is presumed, of the ability of the latter to carry up a portion of the red iron oxide with it. This would appear to afford a valuable distinction between these two metals in toxicological cases, which even Marsh's test does not give.

84. If flowers of sulphur be treated in this way, and the upper leg of the forceps be sufficiently high to be out of its blue flame, for of course it ignites, the steel leg will not be found to have changed further than by being covered with a yellow varnish, which is apparently distilled sulphur; but if the leg be plunged warm into water, it will appear white, from the number of bubbles caused by some chemical action upon it. If instead of sulphur only, a mixture of sulphur and any inorganic substance containing nitrogen, as gunpowder (only of course, for this purpose, that must be well watered and ground into a paste), be used, we shall find the forceps apparently unchanged; but after being plunged warm into water, the upper leg will come out perfectly *black*. No bubbles will be observed through the lens, but the leg, on drying, will be found covered with rust.

85. This curious reaction is also produced when sulphur is thus sublimated in company with such minerals as emit an empyreumatic or nauseous odour when heated in a matrass alone, as, *e. g.*, stinkstone. Such minerals, dissolved in a P glass, give also the nitrogenical reaction referred to in paragraph 48; and one of such (a black mineral found at Mussoorie, in India, as hard as topaz, though consisting apparently only of silica, and emitting a smell of burnt fat when heated in a matrass), produced, when dissolved to a supersaturated extent in borax, a fine cerulean-blue bead of extreme hardness.* Both this mineral and gunpowder (the latter alone, the former combined with sulphur) were found, when ground with water in agate mortars, to give them a deep violet tint, best seen by transmitted light, which is quite ineradicable even by the strongest acids.†

Fig. 8.



86. If sulphur and clear drinking water be heated as at *a c*, Fig. 7, a white sublimate is deposited on the polished leg of the forceps, similar in appearance to that afforded by fusing chloride of sodium. It was thus extracted, though in extremely minute quantity, from even distilled water. To observe slight sublimates, the steel legs of the forceps should be polished bright before use, and then pointed downwards near a window, when the slightest deposit will affect the appearance of the shining surface through a lens.

87. The distinction made by writers on the "blowpipe" between sublimates of metals by means of the different distances at which they are deposited from the assay on charcoal, is apparently based on an error, as these seem to be due chiefly to the violence or weakness, as the case may be, of the superposed blast (paragraph 7). This may be proved by causing the sublimate of the *same* metal, as antimony, to be deposited at different distances, as shown at Fig. 8, at *c c c*, through modified blowing.

88. The same figure shows the manner in which it is

---

* Can the blue colour of the *sapphire* be due to this fact?
† *Nitrate* of silver gives the agate a purplish-black tint.

proposed to utilise the whole effects of the hydrocarbonous pyrocone for substances which cannot be conveniently supported on platinum wire, as metals or alloys, by which the defects of large pieces of charcoal in breaking up and spreading out the pyrocone, and in absorbing and wasting so large an amount of heat, may be avoided. This is by sawing charcoal paste (made of C powder, flour, and water according to the directions given in Plattner's work) into parallelograms about 1½ inches long by ¼-inch deep, and bevelling or slanting off one end as at *b*. This is called a "charcoal mortar," and is supported by a common sewing-needle stuck into one side, as at *a*, Figs. 8 and 10. A cavity is scooped at first in the slanting face of the mortar with the point of a penknife, or, better, an implement like Fig. 9, which is the representation of a broken drift. After some use the mortar burns away as shown in Fig. 10; but no fresh cavity requires to be scooped, as the assay, being hotter than the surrounding paste, burns a place for itself, while the great advantage is obtained by the operator of being able to instantaneously cool and examine the assay at any time, by dipping the whole in a cup of water.

Fig. 9

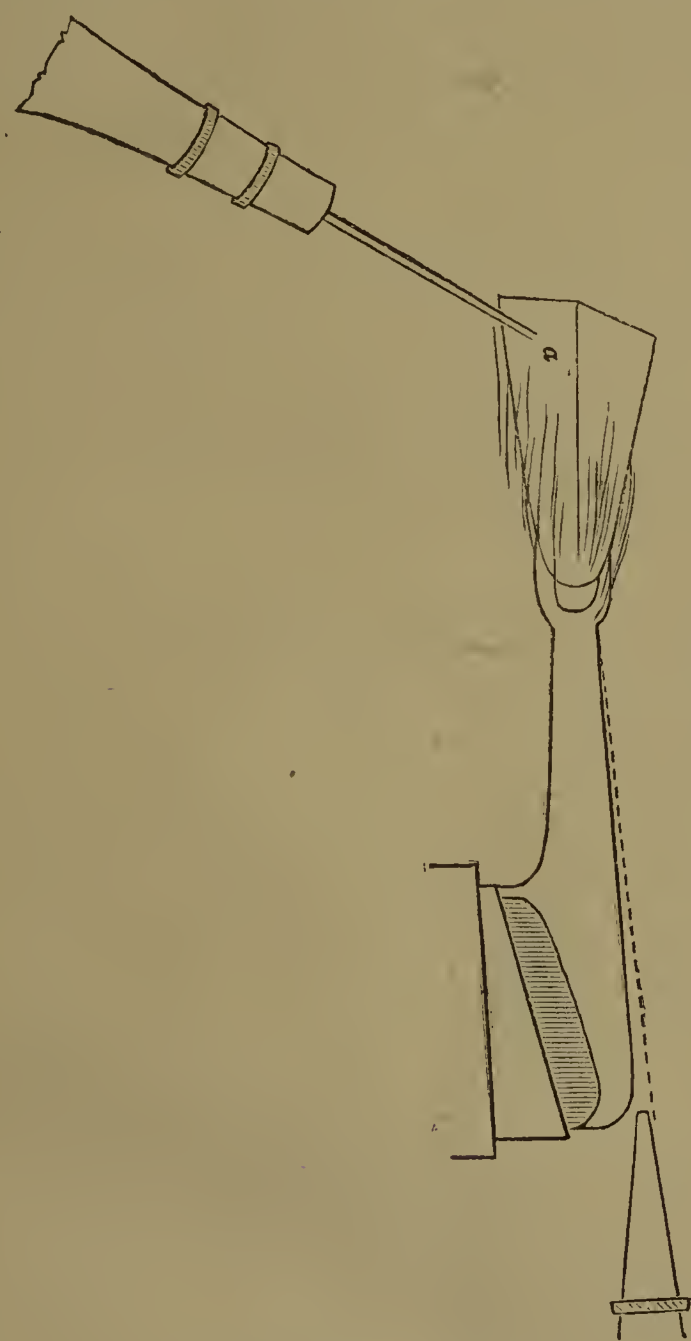


Fig. 10.

Aluminium-Foil as a Support.

89. It has been found that pieces or strips of aluminium-foil, not *under* 3 inches long, withstand the strongest heat of the pyrogene without fusing as well as platinum does, over which the former metal possesses this great advantage, viz., that many metals, as gold, silver, lead, &c., or their alloys, may be fused *upon* it without the least fear of combination. It is thus possible to use this beautiful metal as a support upon which to fuse most other metals, alloys, or metalliferous ores wrapped in a piece of soda paper, instead of upon charcoal,—the advantages being cleanliness, portability, and even economy, for one strip will last out any number of pieces of charcoal. It is rapidly attacked, however, by chlorides and phosphates.

90. [Minerals heated in P. P. upon Al. foil. afford extremely valuable indications of some oxides, which on charcoal would be fused and reduced, as, *e. g.*, *Kupfer nickel* and *Speisscobalt*, which *thus* immediately yield a fine green oxide—" emerald nickel." (6th August, 1872.)]

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 4th, 1873.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*On a Large Meteor seen on February* 3, 1873, *at* 10 *p.m.*" by Prof. Osborne Reynolds, M.A.

On the 3rd of February (that is, yesterday), at 10h. 7m. (as afterwards appeared) by my watch (which was 7 minutes fast), I was walking from Manchester along the east side of the Oxford Road (which there runs 30° to the east of south), I had just reached the corner of Grafton-street, when I saw a most brilliant meteor. I first became aware of it from the brightness of the wall on my left, *i. e.*, on the north-east, which caused me to turn my head in that, the wrong, direction; the first effect was that of a flash of lightning, but it continued and increased until it was equal to daylight. On lifting my head I saw directly in front of me, what had previously been hidden by the brim of my hat, a bright object, apparently fixed in the sky, as though it were coming directly towards me; immediately afterwards it turned to the west, and passed just under the moon (which it completely outshone). I was very much startled when I first caught sight of it, owing doubtless to the rapidity with which it was increasing in size and the directness with which it seemed to be coming. The next instant I saw that it was only an extraordinary meteor. It passed the moon, falling at an angle of I should say 20°, and then ceased suddenly, having traversed a path of about 90°, from the south to the east. The colour of the light was that of a blue-light, or rather burning magnesium. The sky was cloudy, but there was no appearance of redness about either the head or the train. I endeavoured to fix its course by the stars, but it was too cloudy, although I could see here and there a star. The conclusions I came to, there and then, were that its course must have been nearly parallel with the road, which by the map runs, at that point, 30° to the west of north; that when I first saw it, it was about 40° above the horizon and due south; and that it passed about 20° to the north of the moon. (This would make its line of approach from Pegasus). While I was thinking of its course I heard a report, not very loud, but which I connected with it. I judged it was about 30 seconds after the display. I then looked at my watch; it was 10h. 7m. I then walked along, talking to a fellow-traveller who had not quite recovered his alarm. Presently we heard a loud report, like a short peal of thunder or the firing of a large cannon. I immediately looked at my watch; it was then 10h. 10m., so that this second report was from three to four minutes after the display. I have no doubt that this was the report of the meteor, for compared with the other it was like the firing of a cannon to a musket. The time of the second report would make the distance 30 or 40 miles, so that it would have passed over Chester and burst over Liverpool. In this case it must have been a tremendous affair, for the sky was cloudy, and I do not

think I exaggerate when I say that at one instant it was as light as day; the train was very long and the speed great. It ceased suddenly, as when a ball from a Roman candle falls into water; there were no fragments, as from an explosion.

"*Note on Meta-Vanadic Acid*," by Dr. B. W. Gerland. Communicated by Prof. Roscoe, F.R.S.

A solution of copper vanadiate in aqueous sulphurous acid, after part of the latter is removed by boiling, deposits brilliant yellow crystals, the description and analysis of which I gave in the *Journ. of Pract. Chem.*, 1871, p. 97. These crystals are quite uniform in appearance, and contain cupric oxide, vanadic acid, and sulphurous acid. They rapidly change under the influence of air, their beautiful metallic lustre soon disappears, and the colour becomes a dark green. Although formed in a solution of sulphurous acid, they nevertheless decompose when treated, after separation from their mother liquor, with fresh sulphurous acid, so that two kinds of crystals, brown and orange-yellow, now appear mixed together. An excess of sulphurous acid dissolves the former and leaves the latter intact. After filtration, washing, and drying, they form microscopic scales of beautiful lustre and a deep yellow-orange colour; they are free from copper and sulphur, and perfectly unalterable in the air. Heated to 100° C., and even to 130°, they lose no weight, but at a low red heat water is given off, and the residuum consists of vanadium pentoxide, which fuses and crystallises after cooling.

The composition of the substance, previously dried over vitriol, is, according to analysis, the following;—

Water (loss by heating)	8·73
Vanadium pentoxide	91·06
Impurities	0·21
	100·00

These numbers correspond to the formula of the meta-vanadic acid, VHO_3, which requires—

Water	8·97
Vanadic pentoxide	91·03
	100·00

In some instances I obtained the same bronze or gold-like substance by treating copper vanadiate suspended in water with sulphurous acid gas, and in many others the effect of the gas was formation of vanadic oxide in solution. I intend to elucidate this point by further experiments.

The copper vanadiate was prepared by precipitation of ammonium vanadiate with copper sulphate. The mother-liquor contained both copper and vanadic acid. After evaporation the latter is found in the residue as meta-vanadic acid, with the same metallic appearance as that just described, and can be obtained by washing with water. The crystals obstinately retain copper, sometimes as much as 12 per cent, which is best removed by repeated treatment with aqueous sulphurous acid. A sample of the substance so prepared was analysed by Prof. Roscoe, with the following results:—

Weight of substance taken	0·4505 grm.
Loss on ignition	0·0411 ,,

Hence the percentage composition is found to be—

Water	9·12
Vanadium pentoxide	90·88
	100·00

The samples of vanadium bronze obtained by these three different methods had the same composition, the same appearance, and the same chemical properties. It is essentially distinguished from the amorphous brick-red hydrated vanadic acid by its indifference to reagents. Sulphurous acid scarcely acts on it, neither does ammonia, and even a solution of sodium carbonate dissolves it only after very long-continued boiling. In the air it is perfectly permanent. It is very probable that this meta-vanadic acid will become a favourite bronze, valued even higher than gold.

I trust that at some future time I shall be able to render a more satisfactory account of this interesting substance, and particularly of its formation.

Dr. William Roberts exhibited some preparations and experiments bearing on the question of biogenesis. He stated that in the last two and half years he had performed over 300 experiments. His results supported the conclusion that the fungi, monads, and bacteria which make their appearance in boiled organic mixtures are not due to spontaneous evolution, but arise exclusively under the influence of pre-existing germs or ferments introduced from without. His method of experimenting consisted chiefly in exposing organic solutions and mixtures to a boiling heat in glass flasks whose necks had been previously tightly plugged with cotton wool. Two modifications of the experiment were adopted:—

I. In the first modification a 4-ounce flask was employed, and the heat applied directly by means of a gas flame.

II. In the second modification—after the introduction of the materials to be operated on—the elongated neck of the flask was sealed hermetically by the blowpipe above the plug of cotton-wool; the flask was then weighted with a collar of lead, and immersed in a large can of water; the can was then put on the fire and the water boiled for 20 or 30 minutes. During the process of boiling, the flask was maintained in an upright or semi-upright position, in order to prevent any wetting of the cotton-wool plug by the contents of the flask. When the can was cold the flask was removed, and its neck filed off above the cotton-wool, so as to permit free ingress and egress of air.

Flasks thus prepared were maintained at a warmth varying from 50° to 90° F. for long periods,—many weeks and months,—some in the dark and some exposed to the light, with the following results:—

I. Simple filtered infusions of animal or vegetable tissues—a very considerable variety were tried—boiled over the flame for five or ten minutes, in flasks previously plugged with cotton-wool, remained permanently barren. This result was absolutely invariable.

II. More complex mixtures—milk, neutralised or alkalised infusions of vegetable and animal tissues, similar albuminous and gelatinous solutions, mixtures containing fragments of animal or vegetable substances or cheese—yielded variable results. In none of them did fungoid growths make their appearance, but monads and bacteria frequently appeared in abundance.

This seemingly contradictory result was inferred to be due to the ineffective application of the heat in the process of direct boiling over a flame. It was found that many of these more complex mixtures frothed excessively when boiled,—*brisk* ebullition could not therefore be maintained,—particles were spurted about on the sides of the flask, and, in this way, apparently escaped effective exposure to the heat. Even when the boiling was prolonged for 20 or 30 minutes the results were still uncertain,—sometimes the flasks remained barren, sometimes they became turbid and swarmed with bacteria.

III. By the second modification of the experiment much more constant results were obtained,—the flasks remained almost always permanently barren,—and the few exceptions were found to be due to some imperfection in the conduct of the experiment. No exceptions occurred with milk, nor with substances, however complex, which were in actual solution; but when considerable pieces of vegetable or animal substances were introduced into the flasks, bacteria and monads with putrefactive changes occasionally made their appearance in abundance. In these exceptional cases, when the experiments were repeated with

the pieces finely comminuted, or introduced in some other way more favourable to the diffusion of the heat, the flasks remained permanently barren.

Dr. Roberts called attention to the crucial significance of experiments on this subject made in flasks whose necks are plugged with cotton-wool. A plug of cotton-wool acts as an absolutely impervious filter to the solid particles of the atmosphere, while it permits a free passage to the gaseous constituents.

When one of these experiments is effectively performed, the fluid or mixture in the flask may be exposed to the full influence of light, of warmth, and of air, and yet it remains permanently barren. As s ow evaporation takes place the liquid passes through al grades of concentration,—possibly chemical changes of various kinds take place within it,—and still no organic growth makes its appearance for months, and even years; but if the plug of cotton-wool be withdrawn for a few minutes, or a single drop of any natural water, however pure and well filtered, be introduced, then all is changed,—in a few days the clear solution becomes turbid from bacteria and monads, or a mass of mildew covers its surface and soon half fills the flask.

In the face of these experiments it was impossible to doubt that the biogenic power of the atmosphere resides in its dust, and not in its gaseous ingredients; but as to the exact nature of that biogenic power—whether it be a specific germ or a ferment—no sufficient evidence has yet been adduced. Dr. Roberts did not find that diminished pressure of the atmosphere, obtained by sealing flasks hermetically in ebullition, after the mode suggested by Dr. Bastian, materially affected the results.

Dr. R. Angus Smith, F.R.S., said that he was glad to see such uniformity of results. His own experiments, which were very numerous on a similar point, were made differently, but were without exception proving the same. As to the name of the substances in the air, he preferred *germ:* it involved no theory. A germ may be considered that which germinates. *Dust* is an equivocal expression which may cause a popular error. *Polarity* introduces a theory which is so entirely without basis that in our present state of knowledge we may call the inference it presupposes decidedly false.

CORRESPONDENCE.

ADULTERATION OF FOOD ACT.

To the Editor of the Chemical News.

Sir,—From your remarks on the Adulteration of Food Act for 1872, you will not be at all surprised when I tell you that I have seen on several occasions men elected as Analysts by Boards of Works who have had to seek tuition from friends of mine before commencing their duties.

I could point to three Medical Officers of Health holding the appointments of Analyst who know nothing whatever of analytical processes.

I have had eight years' practical experience in chemistry, and can prove that out of six parochial appointments for which I have applied four have been given to men who have *no* experience.

If this matter were sifted by the Local Government Board, what a falling off would be there.—I am, &c.,

L. R. C. P.

Feb. 8, 1873.

MISCELLANEOUS.

University of London.—The following Resolution, passed by the Senate on the 12th inst., will take effect at the Matriculation Examination of June next:—That Greek be no longer compulsory on Candidates at the Matriculation Examination, but be ranked as optional with French and German; so that it shall be sufficient for any Candidate to pass in *any one* of these *three* Languages.

Appointment of Analyst.—Dr. Muter, who already holds the appointment of Analyst for the parishes of Lambeth and St. George the Martyr, Southwark, has been appointed by the Wandsworth Board of Works, Analyst for the district.

London International Exhibition, 1873.—The fourth meeting of the Committee on Surgical Instruments and Appliances took place on the 17th inst. at the Royal Commissioners' Offices, Gore Lodge, S.W. The members present were—Mr. Cæsar H. Hawkins, F.R.S., in the chair; Dr. P. Allen; Mr. R. Brudenell Carter; Mr. W. White Cooper; Dr. H. J. Domville, C.B.; Dr. Arthur Farre, F.R.S.; Mr. J. Hilton, F.R.S.; Mr. Liebreich; Mr. J. Lake, F.R.S.; Dr. A. G. Mackay; Mr. J. Marshall, F.R.S.; Mr. T. W. Nunn; Dr. W. S. Playfair; Mr. R. Quain, F.R.S.; and Mr. E. Saunders. The Committee, after transacting the general business of the meeting, considered the applications—more than sixty in number—which had already been received. They adjourned until Monday, the 17th March, the date of receiving the goods being Tuesday, the 11th March next.

Earliest Discovery of Gas-lighting on the Continent.—From a communication published in the *Moniteur Belge*, of the 13th inst., it appears that Pierre-Henri Minkelers, born at Maestricht, December 2, 1748, Professor of Chemistry and Physical Sciences, at Leuven (Louvain) University, from 1772 to 1797, when the University was suppressed—(it was re-established in 1831 as the Catholic University of Belgium),—made a series of experiments, which resulted in the discovery of gas-lighting on October 2, 1784. This is recorded in a small volume, now very rare, a copy of which is preserved in the library at Maestricht, entitled, "Mémoire sur l'Air Inflammable tiré de Différentes Substances," rédigé par M. Minkelers, Professeur de Philosophie au Collége du Faucon, Université de Louvain: Louvain, 1784. After the suppression of the University, Minkelers was, for a series of years, Professor at the Atheneum of Maestricht, where he died July 4, 1824. One of the streets of the city alluded to, viz., that wherein Minkelers resided, has been named after the *savant*. Owing to the political disturbances of the time gas-lighting was not then introduced on the large scale.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemica papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition o the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 10, 1873.

The following original memoirs and papers relating to chemistry are published in this number:—

Specific Gravity of Absolutely Pure Alcohol.—I. Pierre.—Pure vinic alcohol has at 0° a sp. gr. of 0·815, at 15° 0·80214; propylic alcohol at 0° 0·8198, at 15° 0·80825; butylic alcohol at 0° 0·817, at 15° 0·806; amylic alcohol at 0° 0·8253, at 15° 0·8146. The decrease of density at 15° is for—No. 1, 0·01286; No. 2, 0·01055; No. 3, 0·011; No. 4, 0·0107. Respecting the ordinary alcohols and spirits of commerce, the author states that there are no data to judge what influence

mixtures of the three last-named with vinic alcohol will exert upon the sp. gr. thereof.

Annealing of Glass, and more Particularly on the so-called Batavian Glass Drops.—V. de Luynes.—This essay records the results of a series of experiments made with the view to ascertain the cause of the sudden breaking of the well-known glass drops, which appears to be due to an unequal annealing of the glass.

Poisonous Properties of the Calcium Salts.—J. Rabuteau and L. Duconday.—A toxicologico-physiological essay, from which it appears that the salts of calcium and potassium are muscular poisons affecting the action of the heart. Incidentally the authors observe that metals are the more poisonous the higher their atomic weight, or the smaller their specific heat.

Researches on the Antiseptic and Therapeutic Properties of Silicate of Soda.—M. Champouillon.—The contents of this paper bear upon the effects of silicate of soda as applied to wounds and pus-secreting surfaces. It would appear that the silicate may become useful as an externally applicable agent.

Chemical Investigation of a Stalagmitic Product from the Solfatara of Pouzzoles.—S. de Luca.—After giving a detailed account of the mode of formation of this stalagmite, the author quotes its percentical chemical composition:—Sulphuric acid (calculated as anhydrous), 20·7: sulphurous acid, 3·6; arsenious acid, 1·5; alumina, 7·9; lime, 6·9; ammonia (NH_4O), 5·3; chlorine, 1·5; protoxide of iron, 1·4; silica, 0·8; water driven off at 100°, 27·8; phosphoric acid, magnesia, potassa, and soda together, 22·7.

Action of Bromine upon Bi-Bromosuccinic Acid; Formation of Tetrabromated Hydruret of Ethylen.—E. Bourgoin.—In the first part of this paper the author records at length the mode of preparation of bi-bromosuccinic acid by treating succinic acid with bromine and water at from 165° to 170° in a strong sealed glass tube. From tetra-bromosuccinic acid, obtained by further bromation of the former compound, the author obtained tetra-bromated ethylen, $C_4H_2Br_4$; a colourless fluid somewhat like chloroform in taste; below 0° this substance crystallises.

Another Aniline Colour.—F. Hamel.—When aniline is treated at the ordinary temperature with chloride of sulphur, there is formed a red-coloured pigment, which is soluble in acetic acid, alcohol, and ether, but water cannot be added to these solutions, as a gray-coloured matter is then precipitated from the solution. The chloride of sulphur should be cautiously added to the aniline, otherwise it becomes carbonised. The red pigment is a solid body, and after evaporation of its solution in alcohol, it is obtained as a deep black-coloured crystalline substance.

Journal für Gasbeleuchtung und Wasserversorgung, No. 24, 1872.

The original papers and memoirs published in this number bear only upon the management of gas- and water-works.

No. 1, 1873.

Contains nothing relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 9, 1873.

The following original papers collaterally relating to chemistry are published in this number:—

Newly-Devised Optical Saccharimeter.—Cornee and Duboscq.—Illustrated with a woodcut.

Gas Retorts.—J. P. Serve.—The description of an improvement in these retorts, whereby a better quality of gas is obtained.

Felted Paper (Japanese Paper).—Pavy, Fisetto, and Co.—The description of a process whereby a paper is obtained which may serve instead of cotton tissues.

Newly-Devised Air-Pump.—V. Garcin.—The account of an arrangement whereby a perfect vacuum is readily obtained.

Bibliography.—Ecole des Chauffeurs: Etude sur les Explosions Fulminantes de Chaudières à Vapeur; Appareil de Sécurité: par M. Testud de Beauregard: Paris, 162, Rue Lafayette. 1 vol. with 5 plates, 3 francs. It appears that this work, the second edition, is mainly intended to instruct stokers of steam-boilers how to manage them, and how to prevent accidents. The work is highly spoken of.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2 1873.

This number contains the following original papers and essays:—

Alcoholic Fermentation as Induced by Mucor Mucedo.—A. Fitz.—This essay treats exhaustively on the alcoholic fermentation as produced by fungi, and more especially the Mucor Mucedo.

Œnanthylic Acid.—C. Schorlemmer.—The contents of this paper bear upon the rectification of some assertions made by Franchimont in reference to the author's researches on a crude material. It appears, however, that the acid alluded to agrees in many respects with the heptylic acid obtained by the last-named author.

Synthesis of Ketons; Preliminary Communication.—S. Grucarevic and V. Merz.—When chlorbenzol, naphtalin and iron, or zinc are heated together, hydrochloric acid is evolved, and after purifying the substances formed by this reaction, α-naphtyl-phenyl-keton is obtained. It is a crystalline body, fusing at 75°. Other ketons can be prepared by a similar reaction.

Acenaphthen and Naphthalic Acid.—A. Behr and W. A. van Dorp.—Acenaphthen is obtained from coal-tar. It is a solid crystalline body, fusion-point 94° to 94°; yields by oxidation with chromic acid ($K_2Cr_2O_7+H_2SO_4$ dilute) an acid; formula, $C_{12}H_8O_4$. The calcium salt of this acid yields, by dry distillation with excess of lime, naphthalin; while the acid just mentioned is naphthalin-bicarbonic acid—

$$C_{10}H_6\left\{\begin{matrix}COOH\\COOH\end{matrix}\right.$$

A large portion of this paper is devoted to a discussion on the constitution of acenaphthen.

Behaviour of the Chinons when Treated with Soda-Lime.—C. Graebe.

Synthesis of Naphthalin.—B. Aronheim.—These papers, elucidated by a large number of complex formulæ, are, notwithstanding their intrinsic value, not suited for abstraction.

Journal für Praktische Chemie, Nos. 19 and 20 (double number), 1872.

This number contains the following original papers and essays:—

Researches on the Gases Occluded in and Derived from the Pit-Coals of the Saar District.—Dr. E. v. Meyer.—The continuation of this essay, elucidated by a large number of tables.

Estimation of Phosphoric Acid.—C. Schumann.—This monograph is divided into the following sections:—Gravimetrical estimation of phosphoric acid; volumetrical estimation of the same; analysis of native phosphates.

On Sulpho-Carbonic Acid Ether.—Dr. F. Salomon.—This essay contains a large number of complex formulæ; it is divided into the following chapters:—Preparation of carbonyl-oxysulpho-diethyl—

$$CO\left\{\begin{matrix}SC_2H_5\\OC_2H_5\end{matrix}\right.$$

preparation of carbonyl-oxysulpho-diethyl from the Debus-Bender salt; preparation of carbo-sulphuro-dioxy-ethyl—

$$C_5\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.$$

preparation of the carbonyl-disulpho-diethyl—

$$CO\left\{\begin{matrix}SC_2H_5\\SC_2H_5\end{matrix}\right.$$

preparation of carbo-sulphur-oxysulpho-diethyl—

$$CS\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.$$

preparation of carbo-sulphuro-disulpho-ethyl—

$$CS\left\{\begin{matrix}SC_2H_5\\SC_2H_5\end{matrix}\right.$$

behaviour of the ethers with caustic potassa and with ammonia; comparative review of the boiling-points; specific gravities of these ethers.

Exponents of Refraction (Optical) of the Sulphuretted Substitution Compounds of the Carbonic Acid Ether.—Dr. E. Wiedemann.

Chemical Review of the Year 1872.—Dr. Kolbe.

Les Mondes, February 13, 1873.

The only original paper contained in this number is:—

Petites Annales de Chimie.—E. J. Maumené.—The eleventh part of this monograph, elucidated by a large number of chemical and algebraical formalæ.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No. 12, 1872.

No original papers relating to chemistry in this number.

Archives Neerlandaises des Sciences Exactes et Naturelles, No. 5, 1872

In addition to several essays relating to natural history, this number contains the following original memoir bearing upon chemistry:—

Normal Heptylic Acid.—A. P. N. Franchimont.—The paper treats exhaustively on this acid, formula, $C_7H_{14}O_2$, on its salts, and on fatty acids in general. There is being added to this paper a table exhibiting the sp. gr. of the fatty acids at the same temperature.

La Revue Scientifique de la France et de l'Etranger, February 8, 1873.

No original papers relating to chemistry. We call attention, however, to the two following essays:—

History of the French Artillery from the Earliest Periods to the Present Time.—E. Young.—Illustrated with woodcuts.

The Wines of the Pyrenées Orientales.—P. Oliver.—An exhaustive report on the mode of preparation, quality, &c., of wines.

February 15, 1873,

Contains no original papers on chemistry, but attention is called to—

Nutrition of Plants.—E. Morren.—A lecture on this subject.

Annalen der Chemie und Pharmacie, No. 1, vol. clxvi, 1873.

The following original papers and essays are published in this number:—

Acrylic Acid.—J. Wislicenus.—This paper treats on the direct conversion of acrylic into glycerine-iodpropionic acid by first preparing acrylate of sodium, which is next heated to 130° in a sealed glass tube with hydriodic acid. The glycerine-iodpropionic acid thus obtained is a solid body, fusing at from 83° to 84°. By being treated at a higher temperature with oxide of lead, the acid alluded to is again converted into acrylic acid according to the following formula:—$2C_3H_5IO_2+PbO=2C_3H_4O_2+PbI_2+H_2O$.

Isomeric Lactic Acids.—J. Wislicenus.—The main gist of this paper is, that the author has discovered a new modification of lactic acid in meat, different from those now known.

The Conversion-Products of Glycerine-Iodpropionic Acid when Treated with Moist Oxide of Silver. Hydracrylic Acid and its Derivatives (Begleiter) strictly Companions.—J. Wislicenus.—This essay is divided into the following sections:—Hydracrylic acid, $C_3H_6O_3$ and its salts; oxidation of hydracrylic acid; direct conversion of hydracrylic acid into glycerine-iodpropionic acid; acids formed by the action of oxide of silver upon β-iodpropionic acid. Hydracrylic acid is not an aldehyde of glycerine acid; neither is it an ethylen-lactic acid. Hypotheses on the constitution of hydracrylic acid, and thereto allied substances; formula of glycerine acid.

Influence of Inactive Solvents upon the Specific Rotatory Power of Active Substances.—An optico-chemical essay.

Simple Method of Quantitative Estimation of the Quantity of Alcohol Present in Commercial Chloroform.—The process here described is based upon the fact of cinchonine being less soluble in pure chloroform than in a mixture of alcohol and chloroform. This paper is elucidated by tables exhibiting a series of results of experiments when no alcohol is present in the chloroform. The quantity of cinchonine dissolved at 17° is 0·28 per cent, and when 10 per cent of alcohol is present, 4·76 per cent.

Composition of the Essential Oil Contained in the Fruits of Pastinaca Sativa.—J. J. van Renesse.—It appears that the essential oil alluded to is mainly an octylic alcohol, $C_8H_{18}O$, identical with that described by Zincke. The author gives a detailed account of his researches of the derivatives of this alcohol.

Synthesis of Coniine.—H. Schiff.—The second instalment of a monograph on this subject, illustrated by a large number of complicated formulæ.

Action of Sodium Amalgam upon an Alcoholic Solution of Oxalate of Ethyl.—Dr. H. Debus.

American Journal of Pharmacy, February, 1873.

The original papers in this number all relate strictly to pharmaceutical science.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliquès à l'Industrie for July, August, September, and October (one number), 1872.

This number does not contain any original papers relating to chemistry, but attention is called to the following important essays:—

Economy of Fuel by the Application to all Furnaces, Fireplaces, &c., of Gas-Heating, with Complete Combustion and with Constant Volume (sous volume constant).—P. Charpentier, C.E.

Application to Locomotive Engines of Economica Gas-Heating, with Complete Combustion and with Constant Volume.—P. Charpentier, C.E.

Supplement I. des Catalogs von Warmbrunn, Quilitz, und Co.

Under this heading, we have received a pamphlet, illustrated by numerous woodcuts, and containing the detailed description of a large number of apparatus devised by Dr. A. W. Hofmann for lecture experiments.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 1, 1873.

The original memoirs published in this number do not strictly relate to chemistry.

Journal de Pharmacie et de Chimie, January, 1873.

This number only contains original papers relating to pharmacy and pharmacognosy.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

274. R. H. Patterson, Hammersmith, Middlesex, "Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose."—Petition recorded January 23, 1873.

393. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Petition recorded February 1, 1873.

405. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of essential oils, with a view to their employment as fuel for heating purposes."—A communication from G. Pagliari, Paris.—Petition recorded February 3, 1873.

420. T. W. Dunn and O. Prangley, Trowbridge, Wilts, "Improvements in extracting animal grease and other impurities from wool."—Petition recorded February 5, 1873.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

474. R. Werdermann, Princes Street, Surrey, "An improved mode of reducing metals from their ores and purifying and refining the same."—Petition recorded February 10, 1873.

NOTICES TO PROCEED.

2889. E. T. Hughes, Chancery Lane, London, "Improved machinery for opening, dividing, and incorporating solid, liquid, and aëriform matters, and also for the evaporation and distillation of fluids, and the acceleration of chemical processes."—A communication from C. J. Schultze, Vienna, Austria.—Petition recorded October 1, 1872.

2913. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improvements in the preparation or production of disinfecting, antiseptic, and cleansing liquids."—Petition recorded October 3, 1872.

2934. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improved manufacture of fluids for deodorising and disinfecting purposes."—Petition recorded October 4, 1872.

2974. B. Tanner, Liverpool, "Improvements in the manufacture of artificial manures."—Petition recorded October 9, 1872.

2982. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of alkalies and in apparatus employed therein."—Petition recorded October 10, 1872.

3032. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in treating sulphides, and in obtaining products therefrom."—Petition recorded October 15, 1872.

3052. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in apparatus employed in the manufacture of sulphates of soda and potassa."—Petition recorded October 16, 1872.

3270. C. Rave, Cureghem-lez-Bruxelles, Belgium, "The manufacture from mahogany and other woods of a colouring matter similar to cashoo."—Petition recorded November 4, 1872.

3737. W. R. Lake, Southampton Buildings, London, "An improved method of clarifying and settling varnishes, oils, and other like substances."—A communication from F. Kersting, Grand Rapids Michigan, U.S.A.—Petition recorded December 9, 1872.

3924. W. McAdam, Glasgow, N.B., "Improvements in utilising waste products of chemical and other works, in order to render the same applicable to building and structural purposes."—Petition recorded December 27, 1872.

3970. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "New or improved methods, processes, and apparatus foi depositing upon wrought-iron, steel, and cast-iron, layers of copper or alloys of copper."—A communication from O. Gauduin, J. B. J. Mignon, and S. H. Rouart, Paris.—Petition recorded December 31, 1872.

213. G. Haseltine, Southampton Buildings, London, "Improvements in the manufacture of white-lead, and in the purification of carbonic acid gas used in the said manufacture, and in apparatus therefor."—A communication from A. P. Meylert, New Britain, Conn., U.S.A.—Petition recorded January 18, 1873.

273. R. Pitt, Bath, and S. F. Cox, Bristol, "Improvements in the manufacture of leather, and in apparatus for that purpose."—Petition recorded January 23, 1873.

331. B. Latham, Victoria Street, Westminster, "Improvements in purifying sewage, and treating products obtained therefrom for the production of manure."—Petition January 28, 1873.

PATENTS SEALED.

2276. W. B. G. Bennett, Hackney Road, and J. C. Watt, Notting Hill, Middlesex, "Improvements in the preparation of asphalte, and in the application thereof to the construction of roads and foot-paths and other purposes."—Dated July 30, 1872.

2446. A. R. Arrott, Saint Helens, Lancashire, "Improvements in the manufacture of carbonate of soda."—Dated August 16, 1872.

2491. C. F. Sebille, Paris, "Improvements in the composition known as schisto-, asphaltic, and bituminous beton, and novel applications thereof, together with improved machinery or apparatus in connection therewith."—Dated August 22, 1872.

2538. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the treatment of sewage and in the preparation of manures therefrom."—Dated August 26, 1872.

2617. F. C. Danvers, Ealing, Middlesex, "Improvements in the manufacture of artificial fuel."—Dated September 3, 1872.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 24th.—Medical, 8.
—— London Institution, 4.
—— Geographical, 8½.
TUESDAY, 25th.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 26th.—Society of Arts, 8.
—— Geological, 8.
—— London Institution, 7.
THURSDAY, 27th.—Royal, 8½.
—— Philosophical Club, 6.
—— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
FRIDAY, 28th.—Royal Institution, 9. General Sir Henry C. Rawlinson, K.C.B., D.C.L., F.R.S., Pres. Roy. Geol. Soc., "On Livingstone's Explorations in Africa."
—— Quekett Microscopical Club, 8.
SATURDAY, March 1st.—Royal Institution, 3. Prof. W. K. Clifford, M.A., "On the Philosophy of the Pure Sciences."

TO CORRESPONDENTS.

⁎ Vol. XXVI. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

A Beginner in Chemistry.—Corrected for barometrical pressure. Consult any handbook on chemistry.

H.—You will find the information in Cooley's "Cyclopædia of Practical Receipts" and "Ure's Dictionary."

J. W. Butler.—If you consult the indices of the later volumes of the CHEMICAL NEWS you will find the process you require.

THE CHEMICAL NEWS.

Vol. XXVII. No. 692.

ON ANTHRACENAMINE.

By T. L. PHIPSON, Ph.D., F.C.S.

I obtained this new base in the following manner about two years ago, but up to the present time have not completed the investigation.

Anthracen in powder is added in small quantities at a time to ordinary nitric acid contained in a capsule, which can be cooled if necessary. A soft reddish brown mass is obtained, which melts easily, and can be drawn out into long golden-yellow filaments. This product contains a certain quantity of mononitranthracen, $C_{28}H_9NO_4$, soluble in alcohol, from which it crystallises in small yellow needles. If the temperature is allowed to rise, and the acid boils, several other products are obtained, and much oxanthracen. The product is washed and placed in a flask with tin and hydrochloric acid, diluted with its own volume of water, and boiled quietly for half an hour or an hour, then filtered. The filtered liquid contains chloride of anthracenamine and chloride of tin; the base is extracted by excess of potash, which dissolves the oxide of tin and leaves the anthracenamine. It is necessary to repeat the operation twice to get rid of all the tin.

Thus obtained anthracenamine is a pale yellow powder, forming soluble and crystallisable salts with sulphuric and hydrochloric acids. It is very soluble in alcohol, and water precipitates it from this solution; it is slightly soluble in water; it has only a slight odour, but its taste is hot, pungent, and persistent, very like that of a substance yet unknown which exists in the leaves of the *Arum maculatum*. Its acid salts even when much diluted produce, with a few grains of bichromate of potash, a characteristic emerald-green colour, and finally precipitate a powder of this colour, which is soluble in alcohol. This solution presents no marked peculiarity when viewed in the spectroscope. The reaction is as characteristic of anthracenamine as the blue colour produced in similar circumstances is of naphthalamine. It is not obtained, however, with peroxide of lead, nor with hypochlorite of lime, which appears to produce an oily, brown-coloured chloro compound, but it is obtained with concentrated nitric acid.

From the percentage of nitrogen found in anthracenamine I conclude that its composition may be represented as $C_{28}H_{11}N$. When oxidised by chromic acid (bichromate of potash) it is changed into a new base.

Similar to naphthalamine and its salts, anthracenamine and its compounds are rather easily decomposed. In treating by hydrochloric acid the green oil extracted by pressure from crude anthrancen, I have also obtained a base having properties and composition very similar, if not identical, with those of anthracenamine.

Laboratory of Analytical Chemistry, Putney, S.W.

ON A NEW LOCALITY OF AMBLYGONITE, AND ON MONTEBRASITE, A NEW HYDRATED ALUMINIUM AND LITHIUM PHOSPHATE.*

By M. DES CLOIZEAUX.

A mineral found in 1862, at Hebron, Maine, U.S.A., after a mere tentative examination by Prof. Brush, who announced the presence in it of lithia in considerable quantity, resembled the amblygonite of Penig so closely as to lead to its being looked on as amblygonite. The crystalline system and birefringent optical characters of this mineral were determined by the author in 1863. In 1870 a mineral found in the tin vein of Montebras (Creuse), though resembling the amblygonite of Hebron, appeared to the author to differ from it so far as to justify his designation of it under the name of Montebrasite. Towards the close of 1871 he received another specimen from Montebras, which presented all the characters of the American amblygonite, and which consequently was easily distinguished from the montebrasite. Subsequently, analyses by Pisani, v. Kobell, and Rammelsberg, and optical observations by the author, proved the identity of the montebrasite of Montebras with the amblygonite from Penig. But this is not the case with the amblygonite from Hebron, nor with that from Montebras, which had been analysed by Pisani. These differ from the amblygonites of Saxony and Montebras (which last he had previously named montebrasite) by the absence of soda, by the preponderance of lithia, and the presence of a notable amount of water, while at the same time they contain almost equal proportions of phosphoric acid and alumina.

The differences which these two minerals present in their physical and chemical characters are sufficiently decided to compel our treating them as distinct species. The name amblygonite should be retained for the sodolithic species first discovered at Penig by Breithaupt, and the white or violet-tinted lamellar masses abundant at Montebras will be included under it; the hydrated and entirely lithic species comprising the laminar specimens and the crystals from Maine, as well as some greenish masses from Montebras, would be embraced under the name montebrasite.

The amblygonite of Montebras has only been met with in laminar masses with a faint tinge of violet. These masses exhibit two cleavages presenting nearly the same degree of facility, making with one another an angle of 105° 44′. Close observation shows that the sharpness of the reflected images is generally a little greater on one of the cleavages than on the other, and this induces one to suppose that they do not both belong to equivalent crystallographic planes. The study of some of their optical properties, though presenting certain special difficulties, arising from the small extent of the transparent portions, and the presence of numerous twin plates, even in the specimens that to all appearance are the most homogeneous, has proved that the laminar masses of montebrasite must be referred to the triclinic system. The optic axes are situated in a plane which divides into two very unequal parts the acute angle of 74° 16′ of the two cleavages. This direction is entirely different from that found for montebrasite of Hebron and of Montebras, in which the plane of the axes lies in the obtuse angle of 105° formed by the two principal cleavages.

The appearance of the bars traversing the central ring of each system indicates very distinctly a twisted dispersion, as well as a small amount of inclined dispersion, which is characteristic of a crystal belonging to the triclinic system.

In November, 1871, the author received a specimen from the middle of a mass of amblygonite, from Montebras, resembling the mineral from Hebron. It has three principal cleavages, p, m, t, which the author recognised in the mass from Hebron, the angles between which are $p\,m = 105°$, $m\,t = 135°$ to $136°$, $p\,t = 89°$ to $89°\,15'$.

By means of artificial twins formed of two plates, each of which had been worked perpendicular to the two cleavages p and m, and which were united by their faces p, it appeared that the plane of the optic axes is situated in the obtuse angle $p\,m$, and traverses the edge $\frac{p}{m}$, but that it is not quite normal to m, since it gives angles of about 82° with m and 23° with p. The character of the coloured rings shows that in montebrasite of Montebras, as in that from Hebron, there coexists with the horizontal

* Abstract of a paper read before the Royal Society.

a well-marked inclined dispersion; and these are peculiar to crystals of the triclinic system.

Analyses by M. Pisani.

	Hebron.	Montebras.
Fluorine	5·22	3·80
Phosphoric acid	46·65	47·15
Alumina	36·00	36·90
Lithia	9·75	9·84
Water	4·20	4·75
	101·82	102·44
Specific gravity	3·03, Pisani.	3·01, Pisani.
,, ,,	2·99, Damour.	2·977, Damour.

Wavellite in the form of thin coatings forms a layer over almost all the fissures that occur in the amblygonite of Montebras. In cavities in these coatings are found long thin needles, which have enabled the author to correct the older measurements of this mineral.

M. Pisani has ascertained that the variety from Montebras yields—

Fluorine	2·27
Phosphoric acid	34·30
Alumina	38·25
Water	26·60
	101·42
Specific gravity	2·33

EXAMINATION OF FLAVINE, WITH REMARKS ON THE PROCESSES OF LEESHING AND SCHLUMBERGER FOR PRODUCING DYES FROM QUERCITRON.

By ADOLPH OTT, New York.

The flavine handed to me for examination came from the Stamford Manufacturing Company, 157, Maiden Lane, New York. It represented a light, fallow powder, but sparingly soluble in hot water, and separating again on cooling. The supernatant liquid remained slightly coloured. Warm alcohol, even when diluted, dissolved it quickly,—not so ether. Tartrate of potassa and copper was not reduced by an aqueous solution, showing the absence of sugar. The solution remained clear on adding a solution of glue, thus indicating the absence of tannin. Sodium amalgam, when added to an alcoholic, slightly acidulated solution, gave rise to the well-known purple reaction indicative of quercetin: this reaction was, by the way, also obtained with the deposit of a decoction of yellow bark. The watery solution of flavine decoloured permanganate of potassa, proving the presence of gallic acid. (Test of Monier.) The absence of tannin and the presence of gallic acid was to be considered as proof that the alkaline decoction of the bark had been treated for some time with sulphuric acid.

The above-mentioned tests satisfied me that the sample was a remarkably pure flavine.

The late Professor Bolley, who first made us acquainted with the method of manufacture of flavine, discovered tannin and sugar in flavine analysed by him. My specimen was free from both, but contained gallic acid, the derivate of tannic acid. Since a solution of crude quercitrin assumes a beautiful yellow colour when protochloride of tin is added, this being not the case with my flavine, I drew the conclusion that it was free from quercitrin. This fact was also to be inferred from the presence of gallic acid.

Prompted by the results of this investigation, I began to search whether there existed other analyses of flavine besides that given by Bolley. My researches in this direction remained without result, but I obtained, on the other hand, some notes which strikingly illustrate how slow industries sometimes progress when they are unaided by science. According to James Napier, who published a book on the art of dyeing in 1853, the flavine must have become a commercial commodity in or about the year 1850. Aside from describing its behaviour towards mordants and vegetable fibres, the author states that it contains 4·4 per cent ashes. They consisted doubtless of sulphate of soda. Supposing that the dye-stuff had not been washed out, and that to make the decoction the same quantity of water had been employed as prescribed in the patent specification of Leeshing, it would be very easy to calculate how much soda was used. The quantity was doubtless very large. In 1856 ("Repertory of Patent Inventions") Leeshing, in Glasgow, secured a patent for the treatment of yellow bark, weld (the herb of *Reseda luteola*), and flavine, for the purpose of enhancing their colouring power. He terms "quercitrin" the material obtained from quercitron; "flavetin," the one obtained from flavine. His first process consists in boiling the pigment-yielding substance either with dilute sulphuric or hydrochloric acid, and then washing it out with cold water; a second process consists in previously boiling the dye-woods or dye-stuffs in a weak soda solution, saturating with sulphuric or hydrochloric acid, and boiling for half an hour. The inventor claims that the products thus obtained differ from the original substances in being free from tannin and lime (!), and in having acquired new properties, viz., a greater affinity for mordants and a more vivid and richer colour. Being less soluble in water, they are preferable for the dyeing of such tissues as require a boiling heat in the vat.

Since particular stress is laid upon the increase of the intensity of the colour, it is to be assumed that the flavine contained then a larger proportion of quercitrin. Although the patentee fails to give hints with regard to this point, my supposition has been confirmed by the results of an examination of flavine imported in 1853 into Germany, made by Kœnig. I am unfortunately not in possession of the original paper, yet, according to Gmelin, Kœnig obtained quercitrin in minute crystals by treating the flavine with very dilute boiling sulphuric acid, and by purifying the separated flocculent precipitate,—the ordinary manner.

However, it will always remain a disputed point whether Leeshing was or was not acquainted with the papers on quercitrin by Rigand, who first communicated the fact that this substance is split up if acted upon by dilute mineral acid. This paper appeared in the *Chemical Gazette*, two years previous to the date of Leeshing's patent. I would remark that Rigand was well aware of the fact that mordanted cotton assumes a purer yellow when dyed with quercetin than when dyed with quercitrin.

With regard to the process of Leeshing for enhancing the colouring power of the yellow oak, Bolley, in his "Chemische Technologie der Spinnfasern," says that it was not rational, the quercetin formed being deposited on the bark. But the learned technologist failed to consider that the process in question was also applied to flavine, which was already then a commercial commodity, and, moreover, we may well accept that it was not the intention of Leeshing to extract the colouring matter, partly because the weighty bark with enhanced colouring power brought a proportionally higher price than the pure dye-stuff, and partly because the demand for the latter (the flavine) was undoubtedly not yet sufficiently large. When considered in this light the inventor certainly deserves credit. One of the processes is quite analogous to the preparation of garancine from madder. In both cases a substance combined with glucose must be set free, to be converted into a dye-stuff. In short, the "quercitrin" of Leeshing is a technical product from quercitron.

After the beautiful researches of Bolley and Rigand on quercitrin had already been published, it is incomprehensible that Muspratt (*vide* his "Chemistry Applied to the Arts and Manufactures," ed. of 1860), in treating of the above-mentioned dyes, states that their intensity was

probably enhanced because the colouring matter had become more soluble in water. Yet on the very same page, in giving an abstract of the patent specification of Leeshing, he mentions that the derivates in question, upon being treated with hot as well as cold water, yield *much less* colouring matter than the materials from which they had been produced.

Schlumberger, according to Grothe, treats the bark of the yellow oak as follows:—100 kilos. of the ground wood are mixed with 280 litres of water, acidulated with 25 kilos. of oil of vitriol. This mixture is boiled for two hours, whereupon the bark is washed out, pressed, and dried. For the same quantity of bark Schlumberger takes four times the quantity of acid (of only one-third the strength) of that of Leeshing, but extends the time of treatment to twice the length. These are the only points in which these two methods differ from each other. In speaking of this process, Grothe, in his "Katechismus der Bleicherei, Färberei, und des Zeugdrucks" (p. 103), remarks:—"All the tannin having been separated by treating the bark with sulphuric acid, the colours produced with *quercetin** are much purer and brighter than those obtained with flavine." I am at a loss to comprehend this, for it must be evident to every one that the ground bark, when directly treated with acids, must always contain a larger amount of intermediary products than flavine, even when this latter has not been properly washed out. Grothe, moreover, observes:—"Dye-extracts from quercitron, which contain mainly quercitrin, yield with alum a beautiful yellow," I ask, how is it possible that extracts from quercitron, among which Grothe includes the flavine, dye a beautiful yellow, if yet containing tannin, which, according to Grothe, act injuriously? And, why have extracts of quercitron been produced "with a high percentage of quercitrin," since "recent investigations have demonstrated that they contain quercetin which is principally effective?"

Immediately after this, Grothe remarks:—"For this reason the quercetin is now especially made." If Grothe designates with this name the prepared bark of Schlumberger, he will excuse me for asking why it is that it is not preferable to produce the flavine, which, with regard to purity and intensity of colour, is to the yellow bark as the purpurine of Kopp to the madder of Alsace?

With regard to the behaviour of the peculiar kind of tannic acid contained in the bark of *Quercus tinctoria* many erroneous views seem still to exist. Bolley, in his above-mentioned treatise, observes, for instance, that it was probable that the flavine furnishes a purer yellow than the bark of quercitron, because it has been freed from the greater part of tannic acid. It appears to me that it would have been more correct to state that the flavine produces a purer colour because it consists chiefly of quercetin, as Bolley himself has demonstrated, while the bark contains only the less colouring quercitrin. It is, moreover, not quite clear to me in what manner the tannic acid referred to could act injuriously, since, for dyeing yellow, the goods are not mordanted with iron salts. Besides, the tannic acid from quercitron, according to Schlossberger, yields green, not black, when coming in contact with salts of peroxide of iron. This was already known by Dr. Bancroft when he wrote, in his patent specification, bearing date of 1775:—"This species of bark may be distinguished from all others by its giving with alum a fine yellow colour, and not striking a black upon the addition of iron."

According to Grothe ("Katechismus" &c., p. 103) flavine yields a dark, greenish-black precipitate with salts of protoxide of iron, and citron-yellow with salts of protoxide of tin. This can be comprehended only when it is known that Grothe compiled from the above-mentioned book of Napier, who evidently examined a kind of flavine containing much tannic acid. With salts of protoxide of iron, pure flavine yields a green colour with olive tint; with tin salt the liquid only assumes a brighter colour.

* Schlumberger thus designates his product.

A decoction of bark, however, from which quercitrin has already separated, produces, with salts of protoxide of iron, a greenish black; with tin salt, a light yellowish precipitate. In this latter case the supernatant liquor grows reddish.

In dyeing with a decoction of the bark, the brown colour discovered by Chevreul acts undoubtedly more injuriously than tannin does.

If therefore one chooses, with Bolley, to ascribe the purer yellow of the flavine to the absence of a foreign substance, it would certainly be more correct to seek the cause of this fact in the absence of the brown colour of Chevreul. Every dyer knows that in dyeing with the bark of quercitron high temperatures are not desirable, the brown dye being then absorbed by the fibre, just as in dyeing with aniline violet the red colour contained therein is withdrawn at a high degree of heat.—*American Chemist.*

ON THE

CONSTITUTION OF ALCOHOLS, AS A MEANS FOR THE IDENTIFICATION OF "RADICALS" IN ORGANIC COMPOUNDS.

By S. E. PHILLIPS.

IF glycerine and the sugars be alcoholic, then their relations from that point of view should be consistently estimated.

If alcohol by a certain reaction gives sulphovinic acid, and glycerine alcohol in the same way gives sulphoglyceric acid ($C_4H_5O.HO+2SO_3$ and $(C_6H_7O_4)O,HO+2SO_3$), then it is just possible that all alcohols may manifest one type and be monatomic.

An extended digest of the new views lies before me, which might be tedious to recapitulate in this connection, but it may be well to give a brief view of the monatomic aspect which would have resulted, by applying new facts to the older views, and it does appear that a larger measure of simplicity, and general consistency attends this aspect.

Just as the oxidation of alcohol gives acetic acid, so, precisely, the oxidation of glycol and glycerine alcohols gives glycolic and glyceric acids—

			Acid.	
Alcohol,	C_4H_5O	$+HO+4O=$	Acetic,	$HO+(C_4H_3O_2)O$ and $2HO$
Glycol,	$(C_4H_5O_2)O$	$+HO+4O=$	Glycolic,	$HO+(C_4H_3O_4)O$ and $2HO$
Glycerine,	$(C_6H_7O_4)O$	$+HO+4O=$	Glyceric,	$HO+(C_6H_5O_6)O$ and $2HO$

And all these, by similar generic reactions, give their corresponding amides. Thus, from the alcohols we derive—

Ethylamine, $(C_4H_5\quad)H_2,N$
Glycolamine, $(C_4H_5O_2)H_2,N$
Glyceramine, $(C_6H_7O_4)H_2,N$

And many other substitutional forms, where these radicals replace H in similar ways. From the acids we derive—

Acetamide, $(C_4H_3O_2)H_2,N$
Glycolamide, $(C_4H_3O_4)H_2,N$
Glyceramide, $(C_6H_5O_6)H_2,N$

And many other substitutional forms.

Among the infinite display of varied ammonias, M. Wurtz has synthetically produced one of much interest, which is proved to be identical with *neurine* from the brain, and *choline* from the liver; it is a chloride of ammonium, with the 4 equivs. of H replaced by 3 atoms of ethyl and 1 atom of glycyl (or the radical of glycol), E_3G,NCl, and from this saltic body other variations may be produced, as the hydrate and chloroplatinate, &c.—

$$E_3GNO+HO$$
$$E_3GNCl+PtCl_2$$

M. Wurtz notates its derivation thus—

$$\underbrace{(C_2H_5)_3N}_{\text{Tri-ethylamine.}} \quad + \quad \underbrace{C_2H_4\left\{\begin{matrix}OH\\Cl\end{matrix}\right.}_{\text{Chlorhydrate of Glycol.}} \quad = \quad \left.\begin{matrix}C_2H_4,OH\\C_2H_5\end{matrix}\right\}NCl.$$

It is said the action of HCl upon glycol does not correspond with its action upon common alcohol, for, instead of yielding a chloride of ethylene, it gives a compound of hydrochloric acid with oxide of ethylene. This is a notable instance of the way in which plain facts can be distorted by pre-conceived hypothesis; I would rather say that HCl acts upon glycol precisely as it does upon alcohol—

$$\left.\begin{array}{l}\text{Alcohol, } C_4H_5O + HO \text{ and } HCl = \\ \quad\text{chloride of ethyl} \;..\;..\;..\;..\;..\end{array}\right\} C_4H_5,\ \ Cl \text{ and } 2HO$$

$$\left.\begin{array}{l}\text{Glycol, } C_4H_5O_2,O + HO \text{ and } HCl = \\ \quad\text{chloride of glycyl} \;..\;..\;..\;..\end{array}\right\} C_4H_5O_2,Cl \text{ and } 2HO$$

$$\left.\begin{array}{l}\text{Glycerine, } C_6H_7O_4,O + HO \text{ and} \\ \quad HCl = \text{chloride of glyceryl} \;..\;..\end{array}\right\} C_6H_7O_4,Cl \text{ and } 2HO$$

It is said that glycolic acid is the first member of its series, standing in the same relation to the glycols as acetic acid does to ordinary alcohols. To these relations I see no objection, but, as acetic acid is not the first of its series; so neither is glycolic. Formic acid—

$$HO + C_2H_1O_2O,$$

leads of one series, as formolactic, $HO + C_2H_1O_4,O$, does in the other.

It is further stated that as the glycolic series is intermediate between the acetic and oxalic series, so there are three alcohol series with glycol as the intermediate—

Acetic acid,	$C_4H_4\,O_4$	Vinic alcohol,	$C_4H_6\,O_2$
Propionic acid,	$C_6H_6\,O_4$	Propyl alcohol,	$C_6H_8\,O_2$
Glycolic acid,	$C_4H_4\,O_6$	Glycol,	$C_4H_6\,O_4$
Lactic acid,	$C_6H_6\,O_6$	Propyl glycol,	$C_6H_8\,O_4$
Oxalic acid,	$C_4H_2\,O_8$	Glycerine,	$C_6H_8\,O_6$
Malonic acid,	$C_6H_4\,O_8$	Propyl glycerine,	$C_8H_{10}O_6$

But with the two atoms of oxalic acid the harmony is destroyed. The alcohols are, it is said, mono-, bi-, and tri-atomic, but of the acids it is alleged they are mono- and bi-atomic only.

As *one atom* of oxalic acid is monatomic like the other two series, this discrepancy seems to throw some doubt on the tri-atomicity of the others. Again, what possible connection is there with the oxalic series? If there be any merit in this play upon comparative or parallel series, the way out of this confusion and dilemma is indeed plain and easy, but it leads adversely to another monatomic series.

The acetates are fairly collated with the alcohols, because so derived; the glycerates with the glycols, because similarly derived; and, pray, why not the glycerates with the glycerine alcohols, as equally due to the same process of derivation?

Alcohols, $C_4H_6O_2$	Glycols, $C_4H_6O_4$	Glycerines, $C_6H_8O_6$
Acetates, $C_4H_4O_4$	Glycolates, $C_4H_4O_6$	Glycerates, $C_6H_6O_8$

It is important to observe in this connection that all these three classes of acids are admittedly mono-atomic.

It is deemed *very remarkable* that the boiling-points and specific gravities of the glycols decrease as their complexities increase; but it is evidently quite natural that it should be so, as a glance at the diminishing relative quantities of the denser constituent, O, might fairly pre-indicate—

Propyl glycol, $C_6\,H_8\,O_4$; sp. gr., 1·051; boils at 371° F.
Amyl glycol, $C_{12}H_{12}O_4$; sp. gr., 0·987; boils at 351° F.

The binoxide and bichloride of ethylene, so-called, form an interesting study; they may be aldehydic, $C_4H_3O_2,H$ and $C_4H_3Cl_2,H$, but the former has two isomeric forms, one boiling at 56° F., the other at 68°, and one is probably that of a weak alcohol, $C_4H_3,O + HO$. It is very questionable whether either of them fulfils the definite combining function assumed in modern chemistry.

Thus far all is plain: the analogies are consistent, and it remains to be seen whether the many other alcohol derivatives will bear out this generic comparison.

Modern researches in regard to ethyl and acetyl substitutions appeared to throw a flood of light on the wide question of alcoholic type, and, while working with much interest in these fertile developments, I encountered a check in the counter-statement of Prof. Wanklyn, but, upon reconsideration, it may turn out that the Professor, while doing excellent work in re-calling old facts which had been lost sight of, and confirming them by new researches of a refined and valuable character, has yet been too sweeping in his inferences and deductions therefrom; to wit, that all the recent speculations on ethyl substitutions are in error, and that his is the only view which can be entertained, &c. ("British Association Report," 1868, p. 48). On the contrary, it is now mooted that the general facts of ethyl and acetyl substitutions taking place with evolution of H, atom for atom, are not invalidated by the fact that in many cases this evolution is not apparent, the displaced atoms in the nascent condition entering other forms of combination; though it is freely admitted that the statements made by Frankland and Duppa in regard to the free evolution of H by action of sodium on acetic ether may be in error.

Prof. Wanklyn's equation is thus—

$$\underbrace{3\left\{\begin{array}{l}C_2H_3O\\C_2H_5\end{array}\right\}O}_{\text{Acetic Ether.}} + 4Na = \underbrace{3\left\{\begin{array}{l}Na\\C_2H_5\end{array}\right\}O}_{\text{Ethylate of Sodium.}} \text{ and } \underbrace{\begin{array}{l}Na\\(C_2H_3O)_3\end{array}}_{\text{Sodium Tri-acetyl.}}$$

It is further said "the resulting compound may be viewed in different lights, we may represent the sodium as tri-atomic, thus—

$$(C_2H_3O)_3Na''',$$

or thus—

$$\left.\begin{array}{c}C_2H_3O\\C_2H_3\\ |\quad | \\ O\;\;O\\ |\quad | \\ C_2H_3\\C_2H_3\\Na\end{array}\right\}$$

This drawing is curious in its way, and I hope to have rendered it correctly; but the hydride is more simply notated—

$$\left.\begin{array}{r}C_2H_3O\\C_2H_3O\\C_2H_3O\\H\end{array}\right\}$$

It is not said, however, whether the H, as replacing the sodium, is also tri-atomic.

The sodium compound is called sodium tri-acetyl; by Frankland and Duppa, ethylic sodacetone carbonate; by Geuthier, æthylen-dimethylen-carbonsaure-natron. Assuming that this body does result from the action of sodium upon acetic ether under certain conditions of temperature and confinement, and that, by varying the conditions, a varied reaction would result, we then have to enquire as to the exclusive alternative involved.

We are at liberty to accept or not the ingenious type arrangement, or the Geuthier nomenclature, but there is no other way of explaining the fact of hydrogen's non-evolution than the tri-atomic theory presented.

Upon old views, however, the difficulty is by no means so imperative—

$$\underbrace{3EO + AcO}_{\text{Acetic Ether.}} + 4Na = \underbrace{C_{12}H_9O_6,Na}_{\text{New Body.}} \text{ and } \underbrace{3NaO + EO}_{\text{Ethylate of Sodium.}}$$

There is nothing at all abnormal in this arrangement, and the hydride as an oily liquid, &c., may well be compared with similar analogues and probably homologues; this much, however, is said in deference to the description given of the compound as a hydride, otherwise I should prefer to regard it as a diacetic alcohol—

$$HO + C_{12}H_9O \text{ and } KO + C_{12}H_9O, \text{ where } C_{12}H_9 =$$

$$= \left\{\begin{array}{l}C_4H_3\\C_4H_3O_2\\C_4H_3O_2\end{array}\right\} O + HO,$$

or 2 of acetyl replacing 2 of H in the ethyl radical.

The production of this body is in all probability very analogous to that of the acetines, stearines, triacetic celluloses, &c., all being produced by the same character of reaction, by heating the mixtures in sealed tubes under pressure; they all reproduce the original alcohol, from which they are derived by a reaction with alkalies, and all the nitro-substitutions are more or less explosive.

Heated in a tube under pressure, the following mixtures give as follows:—

Alcohol and acetic acid=ethyl-acetine, *Wanklyn's hydride*
Glycerine and acetic acid=glycer-acetine
Glycerine and stearic acid=glycer-stearine, *Stearine*
Glycerine and nitric acid=glycer-nitrine, *Nitro-glycerine*
Cellulose and nitric acid=cellulose-nitrine, *Gun-cotton*
Cellulose and acetic acid=cellulose-acetine
Glucose and acetic acid=gluco-acetine
Phenol and nitric acid=phenol-nitrine, *Picric acid*
&c., &c.,

and as each of these acids and many others may substitutionally enter all the alcohols, so, conversely, each alcohol may combine with, or substitutionally take into its type, any of the multifarious acid radicals; hence we have here a new horizon of endless fertility, and this feeble glance may, peradventure, be a foretaste of reward and encouragement for my effort to enhance the value and importance of the generic aspects of modern chemistry (see CHEMICAL NEWS, vol. xx., p. 49).

We have looked far and wide to discover any traces of diatomic or triatomic peculiarity in these varied substitutions, and find no indication whatever.

Whether we digest with an alcohol, acetic, or succinic acid, an orcin, or a chinon; both reaction and result appear in a generic sense strictly identical; indeed the very simplest expression of the wide formula would be—

$$\text{Alcohol} + \text{alcohol} - 2HO = \text{di-alcohol}$$
$$C_4H_6O_2 + C_4H_6O_2 - 2HO = C_8H_{10}O_2$$

the alcohol being $(C_4H_5)O+HO$, the dialcohol—

$$\begin{array}{l} C_4H_4O+HO \\ C_4H_5 \\ \hline C_8H_9O+HO \end{array}$$

In like manner—

$$\text{Saligene}+\text{sugar}-2HO=\text{salicine}, C_{26}H_{18}O_{14}$$

And M. Schiff, perhaps the very highest authority in this field, regards it as an alcohol; then—

$$\text{Hydrochinon}+\text{sugar}-2HO=\text{arbutine}, C_{24}H_{16}O_{14}$$

The radical of the chinon replaces 1H in the sugar; hence—

$$\begin{array}{c} (C_{12}H_5O_2)O+HO+(C_{12}H_{11}O_{10})O+HO-2HO= \\ =(C_{12}H_{10}O_{10})O+HO \\ C_{12}H_5\ O_2 \\ \hline \text{Arbutine}=(C_{24}H_{15}O_{12})O+HO \end{array}$$

As the radical of acetic acid, $(C_4H_4O_4)$, is admittedly $(C_4H_3O_2)$, is, then, the radical of diatomic hydrochinon $(C_{12}H_5O_2)$, and that of saligene $(C_{14}H_7O_2)$, and that of glucose $(C_{12}H_{11}O_{10})$, or that of arbutine $(C_{26}H_{15}O_{12})$?

The very great presumption in favour of the affirmative can only be made approximatively certain by an appeal to such varied derivatives as those referred to in the onset of this paper in regard to ethyl, glycyl, and glyceryl.

In the meantime I regard it as almost certain that the varied amines or amides of these radicals are, or can be, obtained, and as we get sulpho-vinic or sulpho-glyceric, so we get sulpho-saccharic acid—

$$HO,SO_3+(C_{12}H_{11}O_{10})O,SO_3;$$

and M. Schiff has, with distinguished ability, supplied the materials whereby we may extend the wide formula so as to include the ammonias, and say further that sugar or an alcohol+ammonia−2HO=a gluco-ammonia or similar body, where the radical of the sugar or other analogue substitutes 1H in the ammonia.

Hence it is that, eschewing the modern notations of M. Schiff, we find that—

Sugar + aniline − 2HO = glucos-anilide	$(C_{12}H_5)(C_{12}H_{11}O_{10})H,N$
Helicin + aniline − 2HO = helicin-anilide	$(C_{12}H_5)(C_{26}H_{15}O_{12})H,N$
Helicin + toluidine − 2HO = helicin-toluidide	$(C_{14}H_7)(C_{26}H_{15}O_{12})H,N$
Aceto-helicin + toluidine − 2HO = aceto-toluidide ..	$(C_{14}H_7)(C_{42}H_{23}O_{20})H,N$

In such cases, it is evident that the radical of the sugar, or glucoside, replaces 1H in the type ammonia.

Salicylous acid + sugar − 2HO = = helicin	$(C_{26}H_{15}O_{12})O+HO$
4 acetic acid + helicin − 8HO = tetraceto-helicin	$H(C_{42}H_{23}O_{20})O+HO$

Or—

$$\begin{array}{l} C_{26}H_{11}O_{12},O+HO \\ (C_4\ H_3\ O_2) \\ (C_4\ H_3\ O_2) \\ (C_4\ H_3\ O_2) \\ (C_4\ H_3\ O_2) \\ \hline C_{42}H_{23}O_{20},O+HO \end{array}$$

Gallic acid + gallic acid − 2HO = tannic acid .. ..
$$\begin{array}{l} C_{14}H_4O_8,O+HO \\ C_{14}H_5O_8 \\ \hline C_{28}H_9O_{16},O+HO \end{array}$$

$$3 \text{ gallic acid}+\text{sugar}-6HO=\text{tannin}=C_{54}H_{22}O_{34}.$$

I have notated this as a glucosan, because, if it be a glucoside, the formula of its genesis is abnormal; but I do not by any means insist on its being a glucosan, as there are other means of abnormality in compounds so complex.

Referring to M. Schiff's tannic acid as a di-gallic, I think M. Wurtz has misinterpreted the true character of these alleged dedoublements. He urges that the radicals of polyatomic acids may accumulate in one, and the same constitution, united together by the intervention of atoms of oxygen, &c., &c., and his notations of di-ethylen-alcohol-diglycolic acid, di-lactic acid, di-tartaric and lacto-succinic acids, all imply two entire radicals in the combination.

On the contrary, I regard these as varied illustrations of the wide formula under consideration, and would appeal to their ammoniacal or other derivative forms as affording a crucial and valid test of their real atomic structure. Moreover, it is apparently immaterial whether the condensation or ingestion be produced by monatomic or by the so-called polyatomic acids.

Glycollic acid + glycollic acid − 2HO = = di-glycollic .. ..
$$\begin{array}{l} C_4H_2O_4,O+HO \\ C_4H_3O_4 \\ \hline C_8H_5O_8,O+HO \end{array}$$

Lactic acid + lactic acid − 2HO = di-lactic acid .. .. $C_{12}H_9O_8,O+HO$
&c., &c.

In the lichen sugars we have—

Orsellinic acid + erythrite − 2HO = = picro-erythrin	$C_{24}H_{15}O_{12},O+HO$
2 Benzoic acid + erythrite − 4HO = = benzo-erythrin	$C_{36}H_{17}O_{10},O+HO$
Orsellinic acid + orsellinic acid − − 2HO = alpha-O-erythrin	$C_{32}H_{13}O_{12},O+HO$

&c., &c.

With very limited means of research, I can merely point out the prominent points in this wide and fertile region; but I cannot conclude this incipient sketch without an emphatic reiteration in regard to the use here made of the alcoholic type. We do not presume to pronounce whether an alcohol be a hydrate $(C_4H_5,O+HO)$ or a hydride $(C_4H_5O_2),H$.

If we could by any means get an omniscient glance at

these atomic arrangements, the probability is it would be neither, but following the representative forms initiated by Liebig and others in the discovery of organic radicals; we simply contend that, whatever arrangement subsists in regard to the structure and reactions or dedoublements of methylic alcohol, that the same in principle equally subsists in ordinary and other alcohols, &c.

Among the glucosides we have—

Saligine + glucose − 2HO = salicine	$C_{26}H_{18}O_{14}$
(?) + glucose − 2HO = populine	$C_{42}H_{22}O_{16}$
Quercitrine + glucose − 2HO = quercitrin ..	$C_{38}H_{18}O_{20}$
Frangulinic acid + glucose − 2HO = frangulin	$C_{40}H_{20}O_{20}$
Chiococcin + glucose − 2HO = caincin	$C_{48}H_{38}O_{20}$
Salicylous acid + glucose − 2HO = helicin ..	$C_{26}H_{16}O_{14}$
2 Benzoic acid + helicin − 4HO = benzo-helicin	$C_{40}H_{20}O_{16}$
(?) + glucose − 2HO = digitalin	$C_{56}H_{48}O_{28}$
Ploretic acid + phloro-glucin − 2HO = ploretin	$C_{30}H_{14}O_{10}$
Ploretin + glucose − 2HO = phloridzin	$C_{42}H_{24}O_{20}$
2 (?) + glucose − 4HO = bryonin	$C_{96}H_{80}O_{38}$
Hydrochinon + glucose − 2HO = arbutin ..	$C_{24}H_{16}O_{14}$
(?) + 4 glucose − 8HO = ericolin	$C_{68}H_{56}O_{42}$
(?) + 2 glucose − 4HO = pinipicrin ..	$C_{44}H_{36}O_{22}$
(?) + 2 glucose − 4HO = daphnin	$C_{62}H_{34}O_{38}$
3 Gallic acid + glucose − 6HO = tannin	$C_{54}H_{22}O_{34}$
Esculetine + glucose − 2HO = esculin	$C_{30}H_{16}O_{18}$
4 Acetic acid + glucose − 8HO = gluco-acetic acid	$C_{28}H_{20}O_{20}$
4 tartaric acid + glucose − 8HO = gluco-tartaric acid	$C_{28}H_{16}O_{28}$

Fraxin, rhamnegin, and datiscin do not exactly correspond with the generic formula of production.

This occasions no surprise or hesitation; the wonder is that, with such complex materials, and projected without any recognition of the law of their genesis, that such abnormal cases are so few; and it demands that the very highest mead of praise should be awarded to the skilful workers in detail who have elaborated such wonderful results.

At the onset I had included esculin among this small minority, but, thanks to M. Schiff, it is now conformable, and further confirmed by an aceto-esculin.

6 acetic acid + esculin − 12HO = aceto-esculin.. .. .. } $C_{54}H_{28}O_{30}$!!

Of course it will be understood that any of these radicals can now be identified from the preceding notations.

Just as the radical of acetic acid, $C_4H_4O_4$, is $(C_4H_3O_2)O+HO$, so that of tetraceto-esculin, $C_{46}H_{24}O_{26}$, is $(C_{46}H_{23}O_{24})O+HO$; and such it is actually found when replacing 1H in aniline—$(C_{46}H_{23}O_{24})(C_{12}H_5)HN$.

Parallel with the above list we have a corresponding series with glucosan ($C_{12}H_{10}O_{10}$) instead of glucose ($C_{12}H_{12}O_{12}$), and here, also, the aceto-benzo-butyric and ethylic glucosanides conform strictly in every case yet collated with the formula.

Then we have a tabular collocation of glycerides and glycides, with mono-, bi-, tetra-, and hexa-substitutions—

Alcohol + glycerine − 2HO = ethylin	$C_{10}H_{12}O_6$
2 Alcohol + glycerine − 4HO = di-ethylin ..	$C_{14}H_{16}O_6$
3 Alcohol + glycerine − 6HO = tri-ethylin ..	$C_{18}H_{20}O_6$
2 Succinic acid + glycerine − 4HO = succinin	$C_{14}H_{10}O_{10}$
2 Acetic acid + glycerine − 4HO = acetin ..	$C_{14}H_{12}O_{10}$
2 Tartaric acid + glycerine − 4HO = glycer-tartaric acid	$C_{14}H_{10}O_{14}$

I merely give a few typical instances, and it is worthy of remark that the alleged diatomics behave in a way quite conformable with alcohol or acetic acid.

There are other complex tartaric substitutions which do not apparently conform to this law of genesis, but such is also the case with ethyl-derivatives; nevertheless there are peculiarities connected with some so-called diatomic acids, and these well deserve a careful study and estimation apart from all preconceived hypothesis.

We have long and deeply entertained this problem, and trust to have made some progress towards its elucidation, but the subject is very wide, and permeates the entire fabric of chemical philosophy.

The power of prediction is a valid test of true theory, and I am content to leave this matter with two inferences, which may easily be tested by any chemist who may be working with the materials involved.

(1). Hofmann gives us glycerine, or glycyl-alcohol .. .. } $C_6H_8O_6$

Di-glycyl-alcohol	$C_{12}H_{12}O_8$
Tri-glycyl-alcohol	$C_{18}H_{20}O_{14}$

On the contrary, by the application of the preceding principles, the law of genesis requires that di-glycyl-alcohol (so-called) should be $C_{12}H_{14}O_{10}$, and that such, it will be found, admits of no doubt whatever.

(2). Hofmann, in comparing a triplet of compounds, notates them all as bibasic.

1. Ethyl-bilactic ether .. .. $\left.\begin{matrix}(C_3H_4O)''_2\\ HE\end{matrix}\right\}\Theta_3$

2. Bi-ethyl-lacto-succinic ether $\left.\begin{matrix}(C_3H_4O)''\\ (C_4H_4O_2)''\\ EE\end{matrix}\right\}\Theta_3$

3. Bi-ethyl-trilactic ether.. .. $\left.\begin{matrix}(C_3H_4O)'''_3\\ EE\end{matrix}\right\}\Theta_4$

On the contrary, by the law of their genesis it becomes plain that the first and third are really monatomic, while the second has three atoms in the basic part.

The first is misnamed: it should be bilactic ether, and the radical of the acid is as thus $(C_{12}H_9O_8)O+EO$.

The third is correctly named: omitting the "bi," it might very plausibly be a tri-lactic acid with 2 atoms of base, and, guided by the notation, I at first so considered it; but it is not such—it is an ethyl-trilactic acid with 1 atom of ether base, or $C_{22}H_{17}O_{12},O+EO$.

The second is misnamed: it is not an ethyl-lactic-succinic acid, but a lacto-succinic acid, with 2 atoms of ether and 1 of HO as base; or, as lacto-succinic acid is in all probability $C_{14}H_7O_8,O+3HO$, so the above would be $C_{14}H_7O_8,O+2EO,HO$.

Referring to the first case, the ultimate explanation is not difficult to foresee. Glycerine + glycerin − 2HO = = di-glycerine − pyro-glycerine, or di-glycyl-alcohol. A higher temperature or more protracted digestion under pressure would give 2 glycerine + glycerine − 4HO = = triglycerine. Whence, then, comes the body spoken of, and called the di-alcohol, or $C_{12}H_{12}O_8$?

As glucose has its glucosan, mannite its mannitan, alcohol its aldehyde, so glycerine has its corresponding glycide; and if atomic proportions of glycerine and glycide be heated in a sealed tube for some time, a generic condensation will take place, the result being—

Glycide + glycerine − 2HO = glycide-glycerine = $C_{12}H_{12}O_8$.

Any or all of these points may easily be proved. I lay less stress upon the lacto-succinic acid than upon the others, involving as it does a wide class of considerations only incidentally referred to in the previous pages and still under investigation.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 20th, 1873.

Professor Frankland, D.C.L., F.R.S., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, Messrs. W. Koch, F. J. Hicks, and Miles H. Smith were formally admitted Members of the society. The following names were then read for the first time—Messrs. Andrew F. Crosse, Thomas Fulcher Best, W. Ram-

say, James William Bantock, and Frederick Douglas Brown. For the third time—Messrs. Waldron Shapleigh, Edward Dillon, B.A., John Perry, George Browurn, Thomas Williams Sheppard, John Carrington Sellars, and Herbert Y. Loram, who were then ballotted for and duly elected.

This being the meeting appointed by the bye-laws for announcing the proposed changes in the Council and officers of the society, the President stated that Dr. Odling had been proposed as the new President, and that the Senior Secretary, Mr. Vernon Harcourt, having announced his intention of retiring from the office, Dr. Russell had been proposed to succeed him. The Vice-Presidents would be Dr. Voelcker, Dr. Roscoe, and Mr. Vernon Harcourt, in place of Drs. Noad, Odling, and Russell; and the other Members of Council, Messrs. Duppa, Divers, M. Foster, Spence, and Armstrong, in place of Messrs. Bassett, Field, Roscoe, Voelcker, and Angus Smith.

Mr. T. Wills then read a paper on the "*Solidification of Nitrous Oxide.*" The author, after briefly sketching the history of the liquefaction of nitrous oxide, proceeded to describe the processes and apparatus with which he had succeeded in obtaining it in a solid state by the evaporation of the liquid. Although the apparatus which he had described was generally the most convenient, the liquid nitrous oxide quickly solidifies if a rapid current of air be passed through it. Unlike carbonic acid, the liquefied gas can readily be preserved for some length of time in an open vessel, provided it be kept still. Liquid carbonic acid becomes solid immediately it is allowed to escape from the vessel containing it, since the vapour tension of the carbonic snow at the time of its formation is much above the atmospheric pressure, whilst liquid nitrous oxide boils at $-92°$ C., and solidifies at $-99°$, so that the vapour tension of the solid is less than one atmosphere. The density of the liquid at 0° is 0·9004, and like liquid carbonic acid it is very expansible and immiscible with water. The author exhibited the formation of the solid nitrous oxide, and performed several experiments with the liquefied gas.

The President, after observing that the Members were much indebted to the author for showing them solid nitrous oxide in such large quantities, said that there were several points which it would be very desirable to investigate in relation to the liquid, such as its rate of expansion between different temperatures, and it was to be hoped that Mr. Wills, who had had so much experience with the liquefied gas, would furnish the society with some further communication on the subject at a future time.

Mr. Walenn said that in 1870 he had made some experiments with the gas, and had succeeded in liquefying considerable quantities in an iron vessel somewhat similar to that exhibited. On inverting it, and opening the stopcock, liquid nitrous oxide came out, and a small quantity of a snow-white substance formed on the side of the vessel in which the liquid was received.

The next paper, "*On Aurin,*" by R. S. Dale, B.A., and C. Schorlemmer, F.R.S., was read by the Secretary. The substance, prepared by treating phenol with oxalic acid and sulphuric acid, and known in commerce by the names of *aurin*, *yellow corallin*, or *rosolic acid*, is a brittle resinous body with beetle-green lustre. To purify it, alcoholic ammonia is added to a cold alcoholic solution of aurin, and the resulting crystalline precipitate of the ammonia compound is decomposed by boiling it with dilute acid, and re-crystallisation from acetic acid. It forms needles or prisms, having a brilliant lustre and of the colour of chromic acid, which retain both water and acetic acid most obstinately; in a similar manner, when crystallised from hot concentrated hydrochloric acid, it retains hydrochloric acid, even after being heated to 110°. Aurin dissolves in alkaline solutions with a red colour, and is re-precipitated on the addition of an acid; it does not melt below 220°. When sulphur dioxide is passed into a hot concentrated alcoholic solution of aurin, and the mixture allowed to cool, a compound of sulphur dioxide and aurin separates in red crystals with green lustre. These appear to contain 1 molecule of sulphur dioxide united with 2 of aurin. Compounds of aurin with potassic bisulphate, ammonic bisulphate, and sodic bisulphate, were also obtained. Leucaurin, $C_{21}H_{18}O_3$ or $C_{20}H_{16}O_3$, which is prepared by the action of zinc-dust on an alkaline solution of aurin, crystallises from its solution in acetic acid in thick prisms. By treatment with acetyl or benzoyl chloride, three atoms of hydrogen are replaced, and *tri-acetyl-leucaurin* or *tribenzoyl-leucaurin* are obtained, both of which are crystalline. The authors have also prepared aurin from pure phenol, and find that it does not retain water in the same way as that obtained from the commercial product. By analysis it gave the formula $C_{20}H_{14}O_3$, whilst the formula $C_{21}H_{16}O_3$ agrees best with that prepared from the commercial product. The authors have commenced the investigation of "peonine" and "azuline," two colouring matters obtained from aurin by the action of ammonia and aniline respectively.

Dr. Frankland said he felt certain the Members would agree with him in returning thanks to the authors for their researches on this important colouring matter, whose constitution was obviously complex. The results obtained were not always so sharp as investigators might wish, but it would appear that the authors had definitely settled that the leuco-body contained three semi-molecules of hydroxyl, and there was no evidence against aurin itself containing them.

In reply to a question from the President, Dr. H. Muller said that the dye was principally used for paper-staining in the form of a lime-lake with excess of lime; it was then a stable colour.

A paper, entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies: I. On Iodide of Ethyl,*" by Dr. J. H. Gladstone and A. Tribe, was then read by the former. The couple employed in the author's experiments was prepared by treating zinc-foil with a dilute solution containing about 1 per cent of cupric sulphate. It thus acquires a black colour from deposition of copper, and is ready for use after being washed and dried. On heating the couple to 100° with ethylic iodide, a gas is given off in small quantity, and ethiodide of zinc formed, which, when gently heated, is resolved into zinc ethyl and zinc iodide. Zinc alone, or zinc etched with sulphuric acid, has scarcely any action on iodide of ethyl at 100°. When the couple acts on iodide of ethyl in the presence of water, a gas is freely given off at the ordinary temperature, which, on examination, proved to be hydride of ethyl. With alcohol the action is somewhat slower, but the gas produced is the same. In the latter case a gummy residue is left in the flask, which, from its properties and composition, the authors believe to be iod-ethylate of zinc. They hope soon to communicate to the society the results of the action of the couple on the homologues of iodide of ethyl.

The President remarked that not only this society, but chemists in general, must feel grateful to the authors for their method of preparing zinc ethyl, a substance which had now become almost as necessary a reagent in the laboratory as alcohol or ether. There was always a great loss in the old way of operating in closed vessels at a high temperature, and although various improvements had been suggested, such as the employment of zinc etched with acids, and the use of an alloy of sodium and zinc, they had been found not to answer. Even when the zinc and sodium alloy was used with the addition of zincic ethide to the ethylic iodide, the operation was very slow, requiring a long time, whilst with the zinc-copper couple the operation was complete in an hour; moreover, by working at a comparatively low temperature, the loss from the formation of ethylic hydride and ethylene was avoided, and the proportion of zinc ethyl obtained was comparatively large.

Mr. Walenn suggested the employment of the metals separated, as the compound formed in contact with the

zinc-copper plate must diminish the action. Perhaps it would be better to employ zinc and platinised platinum, and to introduce a galvanometer into the circuit, so as to observe the changes which took place. He would like to ask Dr. Gladstone whether he had made any experiments with separated couples.

The President said that the low conducting-power of the liquid would probably interfere, a remark confirmed by Dr. Gladstone.

Dr. Russell asked if the authors had examined the black deposit for zinc, as from experiments he had made he should be inclined to believe that it was a sort of alloy of copper and zinc, the product obtained with very dilute solutions of cupric sulphate containing more zinc than with strong ones.

Dr. Muller remarked that the same thing took place in reducing chloride of silver, the reduced silver containing zinc, and evolving hydrogen when treated with hydrochloric acid.

Dr. Gladstone said he was glad his attention had been drawn to this subject, and, as the copper deposited from very weak solutions acted most powerfully, it was possibly from the cause suggested by Dr. Russell.

The last paper, by Mr. A. H. Smee, jun., "*On the Detection of Ammonia in the Atmosphere*," was read by the author. The apparatus employed consists of a glass funnel drawn out to a point, and filled with ice, so that the moisture from the atmosphere, condensed on the outer surface, together with the ammonia and volatile organic matter, can be easily collected. The author has examined the aqueous vapour condensed by this apparatus in various situations, in the country, in a garden in Finsbury Circus, in stables, ferneries, the wards of hospitals, and near the river at Westminster, making determinations of the amount of ammonia present, and also microscopical observations of the crystalline forms left on evaporating the liquid. The paper was illustrated by numerous and carefully-made drawings of these microscopic crystals.

The President thanked the author for his communication, and especially for the interesting microscopical observations; those made in the wards of hospitals might perhaps throw some light on zymotic diseases. He would also like to know whether he had understood the author to say that he had found 0·22 part of ammonia per gallon in the rain-water collected at Carshalton, as the samples collected for him by Dr. Gilbert, at Rothamstead, only contained about 0·02 per gallon.

In reply to a question put by Dr. Attfield, as to whether the same diseases always gave the same microscopic forms, the author said it was very difficult to get isolated cases of any particular disease, as they were generally mixed up together.

The meeting then adjourned until Thursday, March 6, when the following papers will be read:—"On the Action of Hydrochloric Acid on Codeine," by Dr. C. R. A. Wright. "New Processes for Mercury Estimation, with some Observations on Mercury Salts," by P. Hannay. "On a Method of Estimating Nitric Acid," by T. E. Thorpe. "Note on the Action of Acetates upon Solutions of Plumbic Salts, with Remarks upon the Solubility of Plumbic Chloride," by F. Field.

CORRESPONDENCE.

ANALYSIS OF ANIMAL CHARCOAL.

To the Editor of the Chemical News.

Sir,—Having to analyse a considerable number of samples of animal charcoal for carbon, I used the ordinary calcination process. The samples were dried at 350° F., calcined until perfectly white, moistened with carbonate of ammonium, again gently heated, and the loss put down as carbon. A complaint being made that the carbon was too high, I tried the method given by Fresenius, consisting in the removal of soluble matters in hydrochloric acid, throwing on a weighed filter, washing, drying at 212° F., and igniting. On the same sample the first method gave 12·28 per cent, the second method 8·20 per cent.

The same sample analysed in Glasgow was tested between 8 to 9 per cent, I could not get the exact figures. In this case what is the duty of the chemist? Here are two methods, both found in modern books, and giving results differing by 4 per cent. Without entering into the question of what is the cause of this difference, I shall be glad if you will use your influence to bring about a uniform method of testing, so that, at all events, comparative results may be obtained.—I am, &c.,

F.C.S.

February 19, 1873.

DR. MORFIT'S TREATISE ON "MINERAL PHOSPHATES AND PURE FERTILISERS."

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxvii., p. 73, there is an adverse criticism, by Mr. E. Esilman, of certain portions of my recent work, which challenges a reply that I am pleased to be able to give as follows:—

1. In reference to my process B (page 238), which prescribes the use of the alumino-ferruginous pulp as precipitant of hydrochloric solutions of mineral phosphates, it had its inception after the book was written, and its completion only when the manuscript was half through the press. Indeed, it was an after suggestion of the process A (p. 227), which represents my successful efforts to use lime as a precipitant, so as to throw down the phosphate of lime constituent as Colombian phosphate, wholly or nearly free from iron and aluminum associates.

On this account, and because I had become broken down by feeble health, analyses of the products of my experiments were not ready to be appended to the recorded description, and details of the steps by which they were obtained; nor have I yet precised by further essays whether the precipitation was due to one or more constituents of the pulp. Moreover, I saw, in experimenting with the limited quantity of only ten pounds of raw mineral at each operation, that it was almost impossible to adjust the ratio of pulp so as to prevent an excess of the latter, and therefore considered the samples as unjust to the process. But most of the precipitates thus obtained have been since analysed by my direction, and here are the results from two average samples:—

Components.	Precipitate from Navaza Guano.	Precipitate from South Carolina Phosphates.
Water, accidental	12·14	22·74
Ditto constitutional	14·32	9·38
Silicia, sand, &c.	0·37 }	1·24
Sulphate of lime (?)	1·26 }	
Aluminum and iron compounds	14·12	6·83
Lime	23·93	31·77
Magnesia	0·63	0·26
Phosphoric acid	33·55	28·80
Total	100·32	101·02

2. Practically it is immaterial which of the constituents of the pulp may effect the precipitation. If it is the aluminous constituent, then the pulp may be used as it is. On the other hand, if it should be the iron constituent, then it will be only necessary to dissolve out the alumina by means of soda. The aluminate of soda thus incidentally formed is a product which will yield a large profit upon the cost of production.

3. The advantages to accrue from the use of the alumino-ferruginous pulp as precipitant are very obvious and manifold. In the first instance it yields as a by-product, and without cost, a mother-liquor, which is a strong solution of aluminum and iron compounds, containing only that

portion of lime which existed in the raw mineral as carbonate. This liquor is therefore in itself a ready and economical substitute for the specially prepared solutions of the Redonda and Alta Vela guanos employed in the defecation of sewage.

In the second place, it forms an inexpensive source of raw material most admirably adapted, by its pulpy nature and sensitiveness to chemical action, for the manufacture of alum and other aluminum compounds of industrial value.

Thirdly, the production of this mother-liquor in the manner of the process B, affords the means of recovering the original hydrochloric acid indefinitely, by merely evaporating the liquor to dryness in vessels which may act as stills. This latter is a most important consideration in those localities where mineral phosphates abound naturally, and there is a want of a cheap supply of hydrochloric acid. Moreover, the iron and alumina are thus reclaimed also for further utilisation.

4. The precipitation of the phosphate of lime constituent as Colombian phosphate—that is, as a mixture of di- and tri-phosphate, will insure a beautiful product, so chemically sensitive to the influences of the soil, so prompt, potent, and economical as a fertiliser, that it is superior even to the bi-phosphate. It will thus in time render obsolete the use of the latter; and, as a consequence, the production of sulphuric acid will decline, and the manufacturers of fertilisers will have to abandon their old processes for the public benefit. But these are trade considerations which should have no influence whatever with the chemist in his pursuit of scientific improvements. Even though the precipitated phosphate may contain some iron and aluminum compounds, through careless manipulation, the latter will not debase the quality of the former for direct application to the soil.

5. As to the lime or process A, the results of Mr. Esilman's experiments are even more surprising and mysterious to me than those obtained by him in the previous case, and therefore it is not in my power to explain his error. I have only to say for myself, that in following out faithfully the instructions set forth at pages 227 to 238 of my book, I obtained repeatedly, from different kinds of raw mineral, very good precipitates, as the following analyses will show:—

Components.	Precipitate from Calais Coprolites.	Precipitate from South Carolina Phosphate.
Water, accidental	16·60	12·33
Ditto constitutional	6·81	8·60
Silica and sand	0·03	1·54
Sulphate of lime (?)	3·00	5·19
Iron and aluminum compounds	6·01	2·04
Lime	33·23	34·34
Magnesia	0·60	0·55
Phosphoric acid	31·74	32·77
Total	98·02	97·36

This process, by reason of the manner in which it controls the action of the lime as precipitant, and imparts superior characteristics to the precipitate, assumes an importance scarcely less than that of the preceding method, B, just discussed. It has the advantage of requiring less time for its practical operation. It is true that the mother-water from the precipitation by lime will contain more chloride of calcium than that of the B process; but, nevertheless, it retains all the iron and aluminum compounds of the original mineral, and is still suitable therefore, though in a somewhat lesser degree, for defecating sewage; and will yield all its alumino-ferruginous burden as a pulpy precipitate upon the addition of milk of lime in the usual manner.

The only objection to this process, apart from the equally unimportant one of diluting the mother-water with chloride of calcium, is, that it will not allow the reclamation of more than a portion of the hydrochloric acid of the mother-liquor, and then only with greater labour and expense than is required in the previous process.

The water in the products above analysed can be dried out if required.

6. It is, of course, necessary to adjust the proportion of lime precisely to that of the phosphate of lime constituent of the raw mineral, in order to prevent some iron aluminum compounds going down with the precipitate, and at the same time to insure the entire separation of the lime phosphate from the mother-liquor. But this is a manipulation which will grow more and more perfect with time and experience.

7. In respect of my formulæ for chemical analysis, I am well conscious that they are not perfect; but being founded upon my best experience and judgment, I will let them remain for what they are worth, until I see better lights upon the subject than are now open to me. They are, indeed, at fault as to the way of distinguishing the phosphoric acid belonging to lime, from that which pertains to the iron and aluminum constituents of the raw mineral; but chemical science is to blame in this particular, as she has yet to advance to a solution of this problem. By my prescription some portion of the phosphoric acid belonging to the lime is thrown down with the aluminum and iron oxides which may be present. And I record this portion in my table of analytical results as combined with iron and alumina, though it may, in fact, belong largely to lime. Many other chemists report the total phosphoric acid as equivalent to phosphate of lime. Thus, while the latter distinguish in favour of a class, I give the benefit of the doubt to the general public.

In conclusion, my treatise is the pioneer book of its subject, and a work of great labour conscientiously performed, whatever may be its shortcomings. I have endeavoured to present every point in its most improved relations to science and art, according to my best judgment. The competitive processes of other chemists are recorded impartially side by side with my own; and when better information than I possessed on any one point was accessible I quoted it from the proper sources, as in the instances of Spence's and Townsend's methods for treating mineral phosphates of alumina. Failing positive knowledge from any source on incidental matters, I have presumed to give my own ideas for the practical solution of them. It is possible that some of my suggestions for reclaiming certain "wastes" may not be strictly economical for England; but my book is not written for any one region, and there are other countries of different productive and commercial relations where my precepts may fall into suitable soil. Mr. Esilman must excuse me, therefore, if I persist in believing that I pursued the best plan in the construction of my work, even though it has touched, inharmoniously, his professional sensibilities, and stirred within him a carping spirit of criticism.—I am, &c.,

Campbell Morfit.

Southport, February 21, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 17, 1873.

In addition to a series of original papers relating to astronomy, mathematics, meteorology, natural history, and physiology, this number contains the following original memoirs,—

Presence of a Large Quantity of Saltpetre in the Amarantus Blitum.—A. Boutin.—The contents of this phytologico-chemical essay record the results of some experiments, from which the author draws the conclusion that this wild-growing plant, which contains as much as 10 to 12 per cent of nitrate of potassa, draws the nitrogen from the atmosphere, converting that element, by the process of vegetation, into nitrate of potassa. The author further states that this plant may be utilised as a living saltpetre manufacture, as well as for manuring vines, &c. The soil on which the plant grew was never manured at all.

Action of Fuming Nitric Acid upon Aceto-chlorhydrose.—A. Colley.—By the reaction of fuming nitric acid upon aceto-chlorhydrose, there is formed acetonitrose, a beautifully crystalline compound, insoluble in water, soluble in alcohol and ether, fuses at 145°, sp. gr. 1·3487. Boiling water converts this compound into a substance which reduces the tarto-cupropotassic liquor. The author states that the new body is tetraceto-mononitro, $C_6H_7O(C_2H_3O_2)_4NO_3$.

On Atractylic Acid.—M. Lefranc.—In the first portion of this paper the author enters into theoretical discussions on the place which this acid should hold in organic chemistry, it being his opinion that the acid is a conjugated acid, which by saponification behaves as the ether of divalero-sulphuric acid; the result being that there is formed a new body, atractyline; a gum-like amorphous substance, soluble in water and alcohol, insoluble in ether, formula $C_{40}H_{30}O_{12}$.

Researches on the Oxidising Power of the Blood.—P. Schützenberger and C. Risler.—The record of the results of a series of experiments made with blood—some saturated with oxygen, some freed from it entirely—and hydrosulphite of soda. It would appear that the oxygen is not present in the free state, but chemically combined in blood.

Researches on the Influence of the Variations of the Barometric Pressure upon the Phenomena of Life.—P. Bert.—A very important physico-physiological memoir.

Les Mondes, February 20, 1873.

Reorganisation of the Observatory of Paris.—By decree of the President of the French Republic the observatory alluded to has been entirely reorganised. Le Verrier has been appointed director, and the following *savants* constitute the council:—Belgrand, Inspector-General of the Ponts et Chaussées; Vice-Admiral Jurien de la Gravière; Fizeau; Janssen; Tresca; Daubrée; Y. von Villarceau; Wolf; Gaillot-Ray; Marié-Davy has been appointed director of the meteorological observatory of Montsouris (Paris), and Dr. Stéphan director of the observatory at Marseilles. A well selected staff of astronomers, observers, calculators, &c., has also been appointed.

Velocity of Light.—J. Cornu.—With apparatus devised by Fizeau, but greatly improved, the author has recently made new investigations on the velocity of light. The figure found is 298,500 kilometres (about 185,000 English miles) in one second. It is incidentally mentioned that this figure gives for the sun's parallax the value 8″,86, while that of the Great Pyramid is for parallax 8″,8755″.

Aëronautical Ascension.—Gaston Tissandier.—With one of the large air-balloons belonging to the French Post Office Administration (used in the late siege of Paris), an ascension was made a few days ago by the author with the view of obtaining information on meteorological subjects. At 2000 metres above the earth (the starting-point being the large gas-works, Villette, Paris), and after having passed through layers of clouds, the author and his companions found a bright sunlit sky, and a temperature of from 17° to 18°. When descending and entering the clouds—found to be in highly electric state—the temperature decreased to −3°, and the balloon was surrounded with small crystals of ice.

Beet-Root Sugar Production of the Present Season.—Rev. F. Moigno.—France, 375 millons of tons; Germany, 250 millons; total for Europe, 1,025,000 tons against 873,280 tons in 1871-72.

Bibliography.—Coup d'Œil sur le Monde Invisible, par H. Ph. Adan. Paris: A. Ghio, 1873. An excellent treatise on microscopy.

Bulletin de la Société Chimique de Paris, No. 4, 1873.

From the *proces verbaux* of the meetings of this Society we quote the following particulars:—

Reduction of Erythrite by Formic Acid.—A. Henniger.—By the use of a large quantity of acid the author obtained, in addition to a glycol—

$$C_4H_6\left\{\begin{matrix}OH\\OH\end{matrix}\right.$$

a hydrocarbon C_4H_6, a colourless volatile liquid, yielding with bromine a compound $C_4H_6Br_4$, crystallising in rhomboidal shape; fusion-point, 116°.

Constituents of Compressed Coal-Gas.—M. Caventon.—The author is engaged with researches on the condensed substances met with in the *gaz comprimé*, as delivered to consumers in Paris. Some of the liquids condensed emit gas (become vapourised) at 0°; among these the author notices crotonylen, C_4H_6. Its combination with bromine is a solid compound, insoluble in water, soluble in ether and alcohol, fuses at 116°. By the reacting upon acetate of silver an ether is formed from the bromide.

The following original papers and essays are further contained in this number:—

Action of Bromine upon Bibromo-Succinic Acid. Formation of Tetra-Bromated Hydride of Ethylen.—E. Bourgoin.—The more detailed account of a paper already quoted (see Chemical News, vol. xxvii., p. 94).

Quantitative Estimation of Free or Dissolved Oxygen by Means of a Titrated Solution of Hydrosulphite of Soda.—P. Schützenberger and Ch. Risler.—This monograph is divided into the following sections:—Preparation of the hydrosulphite; titration of the hydrosulphite; description of the experimental method.

Statics of Saline Solutions.—Berthelot.

Synthesis of Propionic Acid by Means of Oxide of Carbon.—Berthelot.—By causing oxide of carbon to act upon alkaline solutions in alcohol, there is formed—but only in small quantity—a propionate of the base. A far larger quantity of formiate is formed, but this a secondary reaction. This essay is elucidated by a large number of formulæ.

Gazzetta Chimica Italiana, No. 10, 1872.

Contains the following original papers and memoirs:—

Preliminary Notice on a New Method of Synthesis of Acids of the Aromatic Series.—Dr. E. Paterno.—Although styled preliminary notice, the author details at length, first his theory, and next his results of experiments, confirming his views on the mode of formation of acids of the aromatic series by treating acetinyl-benzine with carbonic anhydride and sodium, whereby an acid is produced identical with Glaser's phenyl-propiolic acid; the new substance being a solid crystalline substance, soluble in water, fusing at 136° to 137°. The author elucidates his theory by a series of formulæ.

Preliminary Notice on Amido-monochlorosulpho-benzidic Acid.—L. Pratesi.—After referring to his researches on the dry distillation of phenylsulphate of aniline, the author records the results of his investigation on the dry distillation of phenylsulphate of toluidine, monochloro-phenolsulphate of aniline, and phenolsulphate of monochloraniline. The first yielded phenol and amidotoluol-sulphuric acid; the second yielded phenol, monochlorphenol, and amido-sulphobenzidic acid; the last gave, besides phenol, the amido-monochlorosulpho-benzidic acid—

$$C_6H_3Cl\left\{\begin{matrix}NH_2\\SO_3H\end{matrix}\right.$$

This paper is elucidated by a large number of complex formulæ.

Chemical Investigation on the Tuber of the Cyclamen.—Prof. S. de Luca.—This monograph records the chemical researches made by the author on the root of a plant indigenous to southern Europe. Among other more common vegetable substances, the root contains ciclamine, an amorphous, neutral, white-coloured substance, void of smell, very hygroscopic, gelatinising in cold water, and converted into glucose at 30° by the aid of synaptase. Ciclamine is converted into ciclamiretine by strong sulphuric acid; and by the action of fused caustic potassa ciclamine yields an acid, which is scarcely soluble in water. The percentical composition of ciclamine is—Carbon, 54·54: hydrogen, 9·12; oxygen, 36·34. It appears that the root alluded to, and more so its active principle ciclamine, acts as a poison on many animals, but pigs eat the root with impunity, and hence the vulgar Italian name of the root is *pane porcino*.

Annalen der Chemie und Pharmacie, Nos. 2 and 3 (double number), 1873.

The following original papers and essays are published in this number:—

Contribution to our Knowledge on the Aromatic Amines.—V. Meyer and O. Stuber.—This monograph, elucidated by a large number of complex formulæ, is divided into the following sections:—Fluid dibrombenzol from dibromaniline; tribrombenzol from tribromaniline; the three modifications of dibrombenzol; isomeric dibromanilines; action of nitrous acid ether upon some amides; benzamide; picramide.

Investigation on the Capability of Addition (Additions Fähigkeit) of Azobenzide.—A. Werigo.

Chemical Formula of Epidote.—E. Ludwig.—A mineralogico-chemical essay.

Franguline and Frangulinic Acid.—A. Faust.—After first referring to the researches of other *savants* on these substances, the author describes at length the methods of preparing, from the bark of *Rhamnus frangula*, franguline and frangulinic acid. The former is, in pure state, a lemon-yellow coloured crystalline substance; fusion-point, 226°; soluble in alkaline fluids, exhibiting an intense cherry-red coloured solution; formula—

$$C_{20}H_{20}O_{10}=\underbrace{C_{14}H_8O_4}_{\text{Frangulinic acid.}}+C_6H_{12}O_6.$$

Frangulinic acid is soluble in alcohol, but barely so in water; it is a crystalline body which, by reduction with zinc, yields, at red heat, anthracen. The combinations of frangulinic acid with bromine and other bodies, are described *in extenso*.

Heptylic Acid from the Hexyl-Alcohol of the Heracleum Oil.—A. Franchimont.—In the introduction to this paper the author reviews at length the results of the researches of other *savants* on acids belonging to this group. The preparation of heptylic acid, $C_7H_{14}O_2$, is then described at length. This substance is, in pure state, a colourless, oily fluid; boiling-point, 223° to 224°; sp. gr. at 24° = 0·9212; not very soluble in water, but miscible, in all proportions, with alcohol and ether. At −18° this acid is solidified, but liquefies again at −8°. The ether, $C_7H_{13}(C_2H_5)O_2$, of this acid, and many of its salts, are next described at great length, and the paper ends with a lengthy discussion on the constitution of the acid and its proper place between the groups of the fatty acids.

Researches on Mucic Acid and Pyromucic Acid.—H. Limpricht.—This exhaustive monograph is divided into the following sections:—Mucic acid, $C_6H_{10}O_8$; chloro-muconic acid, $C_8H_4Cl_2O_4$; hydro-muconic acid, $C_6H_8O_4$; adipinic acid, $C_6H_{10}O_4$; bromo-hydro-muconic acid, $C_6H_7BrO_4,H_2O$; dibromo-adipinic acid; tribrom-adipinic acid; trioxy-adipinic acid; tetrabrom-adipinic acid; pyromucic acid, $C_5H_4O_3$; tetraphenol, C_4H_4O; compounds of bromine and pyromucic acid; tetrabrom-butyric acid; tribrom-ethylen-bromide; iso-pyromucic acid; furfur-alcohol.

Description of an Apparatus for Regulating and Ascertaining the Pressure of the Vapours of Boiling Liquids.—L. Meyer.—Illustrated with engravings.

Estimation of Uric Acid.—R. Maly.

On Nicotine.—Dr. H. Weidel.—This essay, elucidated by a large number of complex formulæ, and woodcuts exhibiting shapes of crystals, treats mainly on the derivatives of nicotine.

Some Erroneous Statements as regards the Formation of Chloroform.—A. Belohoubek.—This essay contains the detailed account of a series of experiments relating to the formation of chloroform.

Analysis of a Magnetic Iron Ore obtained from a Blast Furnace.—O. Vœlker.—The substance alluded to was obtained from the Prevali Iron Works, in Carinthia. The sp. gr. of this partly crystalline mineral is 5·63. Composition, in 100 parts—Fe, 76·2; O, 23·8. Formula, $Fe_{11}O_{12}=(FeO)_9Fe_2O_3$.

Syngenite, a New Mineral from Kalusz (Galicia).—O. Vœlker.—This mineral, found in the saline deposits near the locality alluded to, consists, in 100 parts, of—CaO, 16·97; MgO, 0·46; K_2O, 28·03; SO_3, 48·04; H_2O, 5·81; total, 100·31. Formula, $CaSO_4+K_2SO_4+H_2O$.

Analysis of Epidote from the Untersulzbach Valley, in Salzburg.—F. Kottal.—The mineral alluded to consists, in 100 parts, of—SiO_2, 37·0; Al_2O_3, 22·10; Fe_2O_3, 13·80; FeO, 0·33; CaO, 25·15; MgO, 0·03; H_2O, 0·26

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 16, 1873.

Eau de la Couronne.—M. Ckiandi.—The detailed description of an industrial process of refining the light petroleum oils so as to obtain the eau de la couronne, a cloth- and leather-cleaning liquid; a substitute for turpentine and illuminating oils.

Description of a Hydraulic Press for Laboratory Use.—Thomasset and Noel.—Illustrated by woodcuts. Although termed hydraulic, the fluid is oil not water, and the manipulation quite different from the ordinary hydraulic press, but the effect is powerful although the machine is small.

Spray Producers, So-Called Pulverisators.—J. Gache.—Ingeniously contrived instruments, illustrated by woodcuts.

La Revue Scientifique de la France et de l'Etranger, February 22, 1873.

Contains no papers relating to chemistry, but attention is called to the following essay:—

The Scientific Origin of Nations.—W. Bagehot.

Reorganisation of the Medical Instruction in France.—M. Lacassagne.—A memoir which contains useful hints on the teaching of medical science in its widest sense.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

429. J. P. Sharp, Birmingham, "Improvements in the manufacture of steel and in case hardening, or partially converting iron into steel."

435. C. W. Harrison, High Holborn, Middlesex, "Improvements in the treatment and use of air for the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."—Petitions recorded February 5, 1873.

445. S. J. Mackie, Delahay Street, Westminster, "Improvements in the manufacture of explosive compounds and in the apparatus used in such manufacture."—Petition recorded February 6, 1873.

458. A. Lafargue, Westbourne Park, Middlesex, "Improvements in the production of gas or vapour from hydrocarbon oils or combinations thereof with other matters, and in means or apparatus employed in utilising the same."—Petition recorded February 7, 1873.

528. C. W. Harrison, High Holborn, Middlesex, "Improvements in obtaining oxygen."—Petition recorded February 12, 1873.

NOTICES TO PROCEED.

2941. G. Robbe, Fenchurch Street, London, "A medical preparation applicable to the treatment of what is known as 'foot-and-mouth disease' in cattle."—A communication from J. M. Brunet, Dieppe, France.—Petition recorded October 5, 1872.

2959. W. Lorberg, North Bow, Middlesex, "A new or improved process for the manufacture of soap."—Petition recorded October 8, 1872.

2997. J. W. Perkins, Brixton, Surrey, "The manufacture of artificial fuel."—Petition recorded October 11, 1872.

3017. N. Bickford, Exmouth, "An improvement in the manufacture of soap."—Petition recorded October 14, 1872.

3080. H. Bethell, Victoria Street, Westminster, "Improvements in the treatment of beer, in order to prevent and remove acidity."—Petition recorded October 18, 1872.

3323. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the manufacture of stearic acid."—A communication from E. Diess, Marseilles, France.—Petition recorded November 8, 1872.

3477. P. Jensen, Chancery Lane, Middlesex, "Improvements in the manufacture of steel."—A communication from T. Brooks, Minerva, Ohio, U.S.A.—Petition recorded November 21, 1872.

3525. J. Mitchell, Millbank Street, Westminster, "A new or improved cretaceous hydrocarbon fuel."—Petition recorded November 25, 1872.

205. M. Williams, Wigan, Lancashire, "Improvements in the manufactre of gas."—Petition recorded January 17, 1873.

393. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Petition recorded February 1, 1873.

PATENTS SEALED.

2476. A. Deiss, Plaistow, Essex, "A new or improved process of percolation for the purpose of extracting fatty, resinous, and similar matters."—Dated August 20, 1872.

2529. H. A. Dufrené, Rue de la Fidélité, Paris, "An improved mode of preserving fruit."—A communication from F. Sacc, Neuchatel, Switzerland.—Dated August 26, 1872.

2619. F. R. H. Protheroe, Lydney, Gloucestershire, "Improvements in the manufacture of paper."—Dated September 3, 1872.

2642. C. W. Torr, Aston, near Birmingham, and J. Johnstone, Birmingham, "Improvements in furnaces for heating and melting metals and metallic alloys."—Dated September 5, 1872.

3163. A. Alison, Bayswater, Middlesex, "Improved means of preserving and curing raw meat, in packing the same, and in apparatus employed therewith."—Dated October 25, 1872.

3292. E. J. W. Parnacott, Leeds, "Improvements in artificial fuel, part of which improvements having reference to the means or apparatus employed in the manufacture of the same."—Dated November 6, 1872.

3678. W. R. Lake, Southampton Buildings, London, "Improvements in the manufacture of malleable cast-iron and cast-steel, and in furnaces therefor."—A communication from J. M. Roberts, Burlington, New Jersey, U.S.A.—Dated December 5, 1872.

3853. F. B. Houghton, Borough Road, Southwark, Surrey, "Improved method of, or process for, treating spent hops for the manufacture of paper-pulp."—Dated December 19, 1872.

3882. W. W. Fereday, Dover Road, Surrey, "Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly concentrated manure."—Dated December 21, 1872.

3949. J. Higgin, Manchester, and J. Stenhouse, Pentonville, Middlesex, "Improvements in treating waste liquors containing arsenical or phosphatic compounds, and in obtaining and applying useful products therefrom."—Dated December 30, 1872.

NOTES AND QUERIES.

Becker's Mercurial Earth.—Can any of your readers give me information about a salt known as "Becker's mercurial earth," its composition, how or where I can procure it, and if it is put to any use in the arts? I cannot find it mentioned in any of the modern manuals of chemistry.—G. G. EVANS.

Determining Ammonia in Gas.—Dr. Vogel determines the ammonia by passing gas slowly through aluminum sulphate, whereby an ammonia-alum is formed; he suggests that alum be made in this way for commerce. For determining the quantity of ammonia in tobacco-smoke, he passes it through an alcoholic solution of tartaric acid, when the acid tartrate of ammonia is formed.—*Am. Chem.*

MEETINGS FOR THE WEEK.

MONDAY, March 3rd.—Medical, 8.
—— London Institution, 4.
—— Royal Institution, 3. General Monthly Meeting.
TUESDAY, 4th.—Civil Engineers, 8.
—— Zoological, 8½.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 5th.—Society of Arts, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 6th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. A. Vernon Harcourt, F.R.S., "On the Chemistry of Coal and its Products."
—— Chemical, 8. Dr. C. R. A. Wright, on the "Action of Hydrochloric Acid on Codeine." P. Hannay, "New Processes for Mercury Estimation, with some Observations on Mercury Salts." Dr. T. E. Thorpe, "On a Method of Estimating Nitric Acid." F. Field, "Note on the Action of Acetates upon Solutions of Plumbic Salts, with Remarks upon the Solubility of Plumbic Chloride."
FRIDAY, 7th.—Royal Institution, 9. James Dewar, F.R.S.E., "On the Temperature of the Sun and the Work of Sunlight."
—— Geologist's Association, 8.
SATURDAY, 8th.—Royal Institution, 3. Prof. W. K. Clifford, M.A., "On the Philosophy of the Pure Sciences."

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THE CONSTITUTION OF CITRIC ACID.

By S. E. PHILLIPS.

THE radical of citric acid is considered by Hofmann and others to be ($C_{12}H_5O_8$), and that, as a tri-atomic, it replaces 3H, and, further, that the acid is tribasic.

Of the many doubtful points of speculation, in which too much of positivism and assurance are based, this hypothesis of triatomic or pentatomic equivalence is perhaps one of the weakest.

That any radical or element whatever replaces, or is equivalent to, two, three, four, five, or more atoms of H, is a matter of which I see *no evidence whatever*.

The subject of polybasic organic acids is one that well demands a careful re-examination.

We now moot that citric acid is pentabasic, and that the radical is ($C_{12}H_3O_8$), and as the tribasic citraconic acid gives citraconanilid, ($C_{10}H_3O_4$)PhHN, so we may obtain citranilid, ($C_{12}H_3O_8$)PhHN.

The glyceride CITRIN is a good confirmation of this view. Assuming that a monacid substitution in glucosides or glycerides, &c., requires the formula "*minus* 2HO," an acid with 5HO of base would require a subtraction of 6HO, whence we have—

$$\text{Citric acid} + \text{glycerine} - 6HO = \text{CITRIN} = C_{18}H_{10}O_{14},$$

or, instead of ($C_6H_7O_4$)O+HO, we have—

$$\begin{matrix}C_6H_6O_4\\ C_{12}H_3O_8\end{matrix},O+HO = C_{18}H_9O_{12},O+HO$$

But this glyceride or alcohol is a kind of anhydride to the real glycer-citric acid, which, like the citric acid itself, also seems to saturate 5HO; hence we have—

CITRIN, the so-called anhydride,	$C_{18}H_9O_{12},O+\ HO$
The acid,	$C_{12}H_9O_{12},O+5HO$

The corresponding mannitanide is a still better confirmation—

$$\text{Citric acid} + \text{mannitan} - 6HO = \text{citro-mannitan} = C_{24}H_{11}O_{18}$$
$$2\ \text{citric acid} + \text{mannitan} - 12HO = \text{dicitro-mannitan} = C_{36}H_{16}O_{26}$$

Instead of mannitan, $C_{12}H_{11}O_8$,O+HO, we now have—

$$\begin{matrix}C_{12}H_{10}O_8\\ C_{12}H_3\ O_8\end{matrix},O+HO = C_{24}H_{14}O_8,\ \text{and}$$

$$\left.\begin{matrix}C_{12}H_9O_8\\ C_{12}H_3O_8\\ C_{12}H_3O_8\end{matrix}\right\}O+HO = C_{36}H_{16}O_{26}$$

This latter in some books is given as $C_{30}H_{20}O_{30}$; therefore it is quite clear that we have—

The anhydride,	$(C_{36}H_{15}O_{24})O+\ HO$
The di-acid,	$(C_{36}H_{15}O_{24})O+5HO$

In the case of Hofmann's "citryl triphenyl biamide" he has the number 6, by making the citryl radical tri-atomic, or as replacing 3H, thus ($C_{12}H_5O_8'''$)Ph_2HN_2. On the view we have taken it would be ($C_{12}H_3O_8$)$Ph_2H_3N_2$, and, in accordance herewith, the citric ethers would be—

	Hofmann.	Phillips.
Primary ..	$(C_{12}H_5O_8)O_3+\ EO,2HO$	$(C_{12}H_3O_8)O+\ EO,4HO$
Secondary ..	$(C_{12}H_5O_8)O_3+2EO,\ HO$	$(C_{12}H_3O_8)O+2EO,3HO$
Tertiary ..	$(C_{12}H_5O_8)O_3+3EO$	$(C_{12}H_3O_8)O+3EO,2HO$

One cannot but be struck with the anomalous 3O apart from the radical; we might compare this feature with glycerine, which Hofmann notates with three O apart from the radical, but its derivative constitution and general properties we think will not bear that exceptional interpretation.

The sulpho-glyceric acid is in close parallelism with all other well-known sulpho-acids—

Sulpho-ethylic,	$HO,SO_3+(C_4\ H_5\ \ \ \ )O,SO_3$
Sulpho-acetic,	$HO,SO_3+(C_4\ H_3\ O_2\ )O,SO_3$
Sulpho-glyceric,	$HO,SO_3+(C_6\ H_7\ O_4\ )O,SO_3$
Sulpho-saccharic,	$HO,SO_3+(C_{12}H_{11}O_{10})O,SO_3$
&c.,	&c.,

and it must be distinctly understood that these radicals, as here pourtrayed, replace one H in ammoniacal types.

Naquet gives the following ammonia derivatives:—

	Contain the elements of	Phillips.
Citric acid diphenyl diamide	$(C_{12}H_5O_{10})Ph_2H_3N_2$	$(C_{12}H_3O_8)Ph_2H_4N_2O+HO$
Phenyl citramide	$(C_{12}H_5O_8\ )Ph_3H_3N_3$	$(C_{12}H_3O_8)Ph_3H_5N_3$
Neutral citro-amide..	$(C_{12}H_5O_8\ )\ \ \ \ H_6N_3$	$(C_{12}H_3O_8)\ \ \ \ H_8N_3$

Two citric *i*mides are known—

Phenyl citramic acid	$(C_{12}H_5O_{10})Ph\ H\ N_2$	$(C_{12}H_3O_8)Ph\ H\ N$
Citrimide	$(C_{12}H_5O_8\ )Ph_2H\ N_2$	$(C_{12}H_3O_8)Ph_2H_3N_2$

The first and last are evidently the same, excepting that the first is a simple hydrate or acid form of the latter, which is an *a*mide. Of *i*mides I know nothing whatever!

The *i*mide phenyl citramic acid (!) puzzled exceedingly, nor could I, except with one N, at all imagine such an arrangement of atoms. On venturing this suggestion, and asking for enlightenment in the CHEMICAL NEWS, the reply was "You are right; phenyl citramic acid has only one N to eleven H." The French edition has also made the same error (CHEMICAL NEWS, vol. xxv., p. 47).

This so-called *i*mide, and, at the same time, *aminic acid*, is notated by Naquet as—

$$\left\{\begin{matrix}\left.\begin{matrix}C_6H_4O_3\\ H-H+\end{matrix}\right\}''O_2\\ C_6H_5\end{matrix}\right\}N_2$$

Against the general view here taken, Naquet says that "citric acid has three atoms of H replaced by metals, and the fourth only by acid radicals; hence it is tribasic and tetra-atomic," but he very strangely gives metallic salts containing more than three atoms of base—

Citrate of lead	$=(C_{12}H_3O_8)O+4PbO,HO$
Citrate of copper	$=(C_{12}H_3O_8)O+4CuO,HO$

The following analogues are here given in a provisional sense, as the wide subject of polybasic acids is under consideration—

Tartramide,	$(C_8\ H_3O_8)$	H_5N_2
Tartranilide,	$(C_8\ H_3O_8)Ph_2H_3N_2$	
Tartranil,	$(C_8\ H_3O_8)Ph$	$H\ N$
Tartramic acid,	$(C_8\ H_3O_8)$	H_3NO+HO
Tartranilic,	$(C_8\ H_3O_8)Ph$	H_2NO+HO
Citraconamide,	$(C_{10}H_3O_4)$	H_5N_2
Citracon*i*mide,	$(C_{10}H_3O_4)$	H_2N
Phenyl citraconamide,	$(C_{10}H_3O_4)Ph$	$H\ N$
Citraconamic acid,	$(C_{10}H_3O_4)$	H_3NO+HO
Phenyl-citraconamic acid,	$(C_{10}H_3O_4)Ph$	H_2NO+HO
Comenamic acid,	$(C_{12}H_1O_6)$	H_3NO+HO

At the outset of this enquiry I was puzzled by the special prominence given to the *tri*amide form for the citric ammonia, and the diamide form similarly assigned to succinamide and other supposed diatomics. This is well seen in the following triplet:—

Phenyl benzamide,	$(C_{14}H_5O_2)Ph\ H\ N$
Phenyl succinamide,	$(C_8\ H_3O_4)Ph_2H_3N_2$
Phenyl citramide,	$(C_{12}H_3O_8)Ph_3H_5N_3$

How little this is founded on fact may be seen in the following, taken from the same authority (Watts's "Dictionary"):—

Aniline + succinic acid − 2HO = phenyl-succinic acid, ($C_8H_3O_4$)PhH_2NO+HO.

Aniline + citric acid − 4HO = phenyl-citramic acid, ($C_{12}H_3O_8$)PhH_2NO+HO.

2 aniline + citric acid − 4HO = diphenyl-citramic acid, ($C_{12}H_3O_8$)$Ph_2H_4N_2O$+HO.

Now the amide or ammonia form of phenyl-citramic acid would necessarily be ($C_{12}H_3O_8$)PhHN, which proves the Hofmann radical to be an impossibility, and, for the

complete confirmation of the burden of this paper, it only needs that we should obtain the corresponding diphenyl citramide, $(C_{12}H_3O_8)Ph_2N$.

Finally, it is plain that if these principles be applied to the identification of organic radicals, that the diatomic alizarine, and an infinitude of others, will vanish into a clear comprehension of the simple truth.

ON THE DISSOCIATION OF OXIDE OF MERCURY.

By J. MYERS.

Debray*, in 1867, promised that he would publish his researches on the dissociation of mercury, but he has not yet done so. No older researches on this subject exist, except those of Pelouze and Gay-Lussac†, from which it resulted that the decomposition of the two modifications of that oxide begins at the same temperature. My experiments only relate to the red modification of the oxide of mercury, which, of course, I took care to prepare in pure state, so as to be quite free from suboxide, which is decomposed at 100°. The red oxide of mercury of commerce always contains suboxide; and I therefore prepared the oxide by ignition (gentle heating rather) of the nitrate prepared from pure mercury, obtained by reducing crystalline cinnabar by means of iron, the metal being next dissolved in nitric acid. The oxide so prepared was not, however, quite free from suboxide, which was eliminated by heating it with nitrate of ammonia. The oxide was put into a glass tube which had previously been weighed, and which was connected with a Geissler pump. Prior to this I had, however, measured—(1), the cubical capacity of the balloon of the pump, taking a mark made on it as starting point; (2), the cubical capacity of the tube and other parts of the apparatus; (3), the diameter of the barometer tube of the pump. This enabled me to control the indications of the manometer (pressure gauge) by means of the balance, and I found that they agree with each other.

The tube filled with oxide was in these experiments heated to the requisite temperature by the following means:—(1), in an air bath kept at a constant temperature by the modified Schlösing's temperature regulator; (2), in a bath of mercury and sulphur for temperatures of 350° and 440°; (3), a bath of sulphur and zinc for temperatures of 400° to 560°, the heat being regulated by adjusting the gas-flame by a well-made tap. The determination of these high temperatures was effected by the aid of Berthelot's air thermometer. Before weighing the tube it was always cooled by the aid of a Liebig condenser. In the first experiments the tube was heated to 105·5° for an hour; the manometer did not indicate any pressure. In the second experiments the tube was heated to 150° for an hour; the result was that oxygen was evolved, but in too small a quantity to exert any pressure; a deposit of mercury was also visible. At 240° the tension of the mercury was, after an hour's heating, 2 m.m., and did not increase by continuing the experiment. For about two hours the temperature was kept at 293°, and the tension was 2½ m.m. No increase was observed during the second hour. These four experiments prove that the maximum of tension is reached in a short time, while it (the tension pressure) is very small, and amounts only to a very small fraction of the atmospheric pressure. In the fifth experiment I heated the tube to 350° in an air bath, the temperature of which was kept constant, and determined by an air thermometer. After having continued the application of heat to the tube for about the same time as in the previous experiments, the pressure exerted by the oyxgen amounted to 8 m.m., which was found to be the maximum for this temperature. I heated the tube to 400° for five hours; at the end of this period the manometer still rose (mercurial gauge), the pressure was 16 m.m.

It was not an easy matter to keep the temperature of the boiling sulphur bath constant. The tube was in it for thirteen hours; after seven hours the pressure was 39 m.m., and it increased during the last 6 hours by 27 m.m. The tube was next transferred to a bath of molten zinc kept at 560°. After seven and a quarter hours the pressure of the oxygen under these conditions was 343 m.m. After three hours and a half the pressure was 271·5, and by observing and noting the reading of the manometer every quarter of an hour, I found that maxima and minima occur as exhibited by the following figures:—304, 369, 315·5, 323, 329·5, 334·5, 339, 343.

This experiment also enabled me to estimate the melting-point of the ordinary zinc of commerce, which I found to be 440°. The course of the experiments just alluded to, and the fact that in no instance a decrease of the tension of the oxygen occurred either when the cooling was rapidly or slowly effected, rendered probable the view with which I undertook these researches. The looseness of the combination of mercury and oxygen made it reasonable to expect that an anomaly of the dissociation should arise, and this the more so if Pfaundler's* definition of dissociation is viewed as correct. But the main point of that definition, viz., that by a given constant temperature as large a number of molecules are split up as are by contact reunited, so that, in fact, a condition of equilibrium is obtained (maximum of tension), does not, I think, hold good in the case of oxide of mercury; because only the first parts of the definition just given obtains with it and not the second.

In order to make sure of the correctness of my first researches, the results of which were somewhat contrary to my expectations, I again placed the tube in a bath of boiling sulphur, having first filled the apparatus with 66 m.m. of oxygen, the same quantity left in the apparatus at a previous experiment. The stopcock of the air pump was so adjusted that the balloon of the pump did not form part of the apparatus. The tube was heated for twenty and a half hours, the pressure of the O increased by 60 m.m.; yet in this case also, the increase of the pressure was not uniform, as may be seen from the subjoined tabulated form:—

Duration of Experiment. Hours.	Reading of the Manometer. At the Beginning. m.m.	Reading of the Manometer. At the End. m.m.	Increase per Hour. m.m.
3¾	66	74	2·13
2¾	60	87	2·54
4¼	87	101⅔	3·45
4	101⅔	115⅔	3·50
4	115⅔	123⅔	2·50

After this, the stopcock was so adjusted that the balloon became part of this apparatus, and then the heating was continued for fifty-one and a quarter hours (but consecutively only for twenty-four); the tension of the oxygen rose to 165·5 m.m., an increase of 47·5 m.m. On opening the stopcock, the tension in the apparatus was 418 m.m. Thus, if the capacity of the apparatus applied in this instance had been the same as before, the tension would have been increased by 111 m.m., and hence it is evident that the evolution of oxygen is only slowly decreasing. After having exposed the apparatus to heat for eighty-five hours, and finding that the end of the experiment was far from being obtained, I again introduced oxygen into the apparatus until the tension became 337 m.m. Taking the results of the previous experiments as basis, it would have required two hundred hours' heating to reach this tension. I next heated the tube again for fully fifteen and a half hours, and the results of this operation are quoted in the subjoined form; but I ought to observe that the reading off took place from a distinct mark, 738·1 m.m. above the mercury contained in the reservoir:—

* *Comptes Rendus*, 1867, 603.
† *Ibid.*, vol., xvi. 310.

* *Pogg. Ann.*, 131, p. 54.

Duration of Experiment. Hours.	Reading of Barometer at Beginning.	Reading of Thermometer at the End.	Reading on the Barometer Tube.	Difference.	Calculated for the Capacity of the former Table.
4½	757·3	10¼	318	2·3	5·13
	754·2	10	323		
3¾	754·4	7½	318	1·3	3·03
	757·1	10¼	320		
7¼	758·4	6¾	315	3·2	2·47
	757·2	14½	329		

The figures of the sixth column indicate that the evolution of oxygen decreases very slowly while the pressure of the gas increases. The arrangement of the apparatus did not admit of experimenting with the oxygen at atmospheric pressure, but I have no doubt that at the temperature of boiling sulphur a maximum of tension for the oxygen evolved from the oxide of mercury does not occur. The fact, however, of the very slow decrease of the evolution of this gas is, I think, accounted for by the weakening of every chemical action by pressure. I did not consider it necessary to repeat these experiments at higher temperatures, but I made some at lower temperatures which proved that for that temperature there exists a maximum of tension of oxygen of 8 m.m., as also proved by my first experiments. Even when the heating of the tube is continued for a period of thirteen hours, no difference is produced in the reading of the manometer.

The results of this investigation may be summarised as follows:—The dissociation of oxide of mercury is, up to a certain temperature, quite normal; but the apparatus (tube containing the oxide) being cooled, either more slowly or more rapidly, no decrease of tension of the oxygen is observed. When the limit of the above temperature is exceeded, no maximum of tension is reached, because the dissociated molecules have obtained more motion than is required for their combination. For every temperature, therefore, above that limit the decomposition of the oxide is complete, provided the application of heat be continued long enough.

The hypothesis is often brought forward that a temperature for every substance may be assumed to exist, at which the motion of every molecule is just so great that its tendency of combination with other substances is equal to O. It is clear that this temperature must differ for each individual substance, and also differs towards other bodies. I think that, as regards mercury and oxygen, this temperature is about 400°. This is also proved by the fact that when mercury is boiled in open vessels the oxide is formed at a distance of some few centimetres above the surface of the boiling fluid. When, however, mercury is heated to only 300°, some oxide is also formed, but it then remains close to the fluid. This can only be explained, seeing that the temperature at the distance of some few centimetres above the surface of the metal is far lower, by assuming that at 350° the molecules of mercury possess the maximum of motion with a minimum tendency of combining with oxygen. The temperature 400° is in all likelihood too high as limit. I have, at present, had no time to experiment with the yellow oxide of mercury, but I hope shortly to do so, and also to operate with the oxides of silver and gold, and thus obtain a clue to the slowness of the dissociation of mercury.—*Ber. de. Deutsch. Chem. Gesells.*

ANALYSIS OF ANIMAL CHARCOAL.

By T. L. PATTERSON, F.C.S.

THE letter of your correspondent "F.C.S." (CHEMICAL NEWS, vol. xxvii., p. 104) prompts me to communicate a few observations on the above subject. On a future occasion I hope to go more fully into the composition and analysis of charcoal.

Animal charcoal when new and of good quality contains about 4·5 per cent of organic matter. A small portion is soluble in water, the greater part is soluble in acid, and the remainder is insoluble in either menstruum. Now, when charcoal is ignited the loss of weight is equal to the carbon + organic matter + water. Whereas when it is treated with acid, and the insoluble collected on a filter, washed, dried, and weighed, the contents of the filter, after deducting the sand left on ignition, consists of carbon and only the small portion of organic matter insoluble in the acid solution. If the result obtained by the ignition method after deducting the water be recorded as carbon, it will be found to be 4 per cent or so, more or less, than that obtained by solution; because in the first case the total organic matter is included, while only that portion insoluble in acid is recovered in the latter method.

It is the practice of most chemists in analysing animal charcoal to estimate water, carbon, carbonate of lime, sulphate of lime, oxide of iron, alkaline salts and sand, extending the difference as phosphate of lime and magnesia. In my future communication I will endeavour to show how erroneous this is, not only with regard to the organic matter, but also as to another constituent of the char. One of the constituents included in this difference is organic matter, which I believe ought to be always accurately and separately determined, since it not only enhances the value of the analysis, but gives important information as to whether the char has been properly burned. Thus when the organic matter amounts to 5 per cent, it may be taken as an indication that the char has not been long enough burned, or high enough heated in the process of its manufacture. And, conversely, when it falls much below 4 per cent it is likely the sample has been over-burned. Home-made char is sometimes under-burned, while that of foreign origin is as often over-burned. Of the two evils under-burning is the least.

Having during the last five or six years analysed a great many samples of charcoal from various sources, and having invariably determined the organic matter contained therein, I may say as the result of my experience that in new charcoal it amounts to between 3·23 per cent and 5·9 per cent dried at 212° F. And in old char, or the stock charcoal of sugar houses, the organic matter fluctuates between 0·2 and 1 per cent, according as the char has been carefully or imperfectly re-burned.

I always dry from four to five hours in the water-bath, and not at 350° F., because at the latter temperature a portion of the organic matter is driven off, and a high result obtained.

There is just one other remark about the estimation of moisture in char which I would like to make at present, because I believe from not knowing it many have been led to too low a result. When a sample of charcoal contains 5 to 10 per cent, and the water be determined in a portion of the ground as well as in the unground charcoal, it will be found that the result obtained in the latter case exceeds that in the former by 1 or 2 per cent, and proportionately less when the original sample contains 1 per cent and less of water. This shows that the char loses moisture during the operation of grinding. Consequently in making a full analysis it is necessary to make two water estimations, one in the ground and another in the unground portion. The former is that used for making up the results of the analysis and calculating to dry charcoal, while the latter is that reported as actually existing in the sample.

ON THE SULPHUR DEPOSITS OF KRISUVIK, ICELAND.

By CHARLES W. VINCENT, F.C.S.

THE canton of Krisuvik, in the district of Gullbringu, in the south-west corner of Iceland, has long attracted great interest on account of its boiling mud cauldrons, hot springs, and, above all, its "living" sulphur mines; these are all arranged in lines, evidently corresponding to the great volcanic diagonal line stretching from Cape Reykjanes

to the lake of Myvatn. At the present time, the greatest amount of volcanic activity is manifested at the southern end of this line, in the district some peculiarities of which I now propose to bring before you.

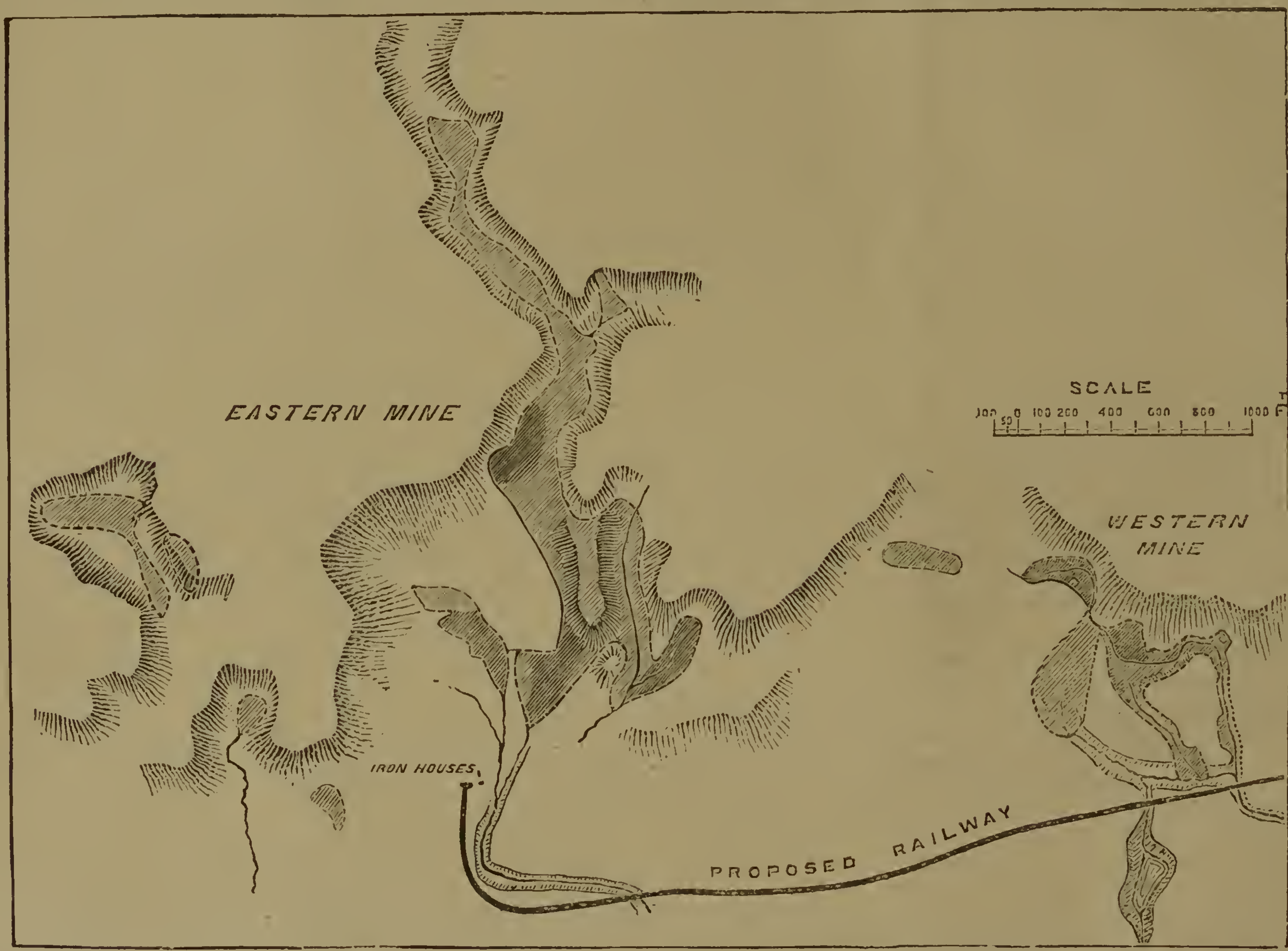
In the last century it was the northern end of the volcanic diagonal, near about Myvatn, where, according to the Icelandic records, the kind of pseudo-volcanic action was most vigorous, by which the boiling springs are set in operation and the sulphur deposits are formed; but a violent eruption of the mud volcano, Krabla, to a great extent buried the then active strata beneath enormous masses of volcanic mud and ashes, so that the energy has been probably transferred along the line southwards.

The Krisuvik springs are in a valley beneath some high mountains (see plan; the shaded portion represents the sulphur beds surrounding the active springs). They are reached by a track, so narrow that there is no more than room to enable horses to pass along it—across the brink and along the side of a vast hollow, termed the "kettle." Following this rude track, the "Ketilstip," the summit of the range of hills, is reached which overlooks Krisuvik. In the midst of a green and extensive morass, interspersed with a few lakes, are cauldrons of boiling mud, some of them 15 feet in diameter, numberless jets of steam, and boiling mud issuing from the ground, in many instances to the height of 6 or 8 feet. Sir George Mackenzie (who was accompanied by Sir Henry, then Doctor, Holland, now the President of the Royal Institution), in his justly-celebrated "Travels in Iceland, in 1810," gives a vivid word-picture of the scene. "It is impossible," he writes, "to convey adequate ideas of the wonders of its terrors. The sensation of a person, even of firm nerves, standing on a support which feebly sustains him, where literally fire and brimstone are in incessant action, having before his eyes tremendous proofs of what is going on beneath him, enveloped in thick vapours, his ears stunned with thundering noises. These can hardly be expressed in words, and can only be conceived by those who have experienced them."

The photographs which I have the honour to exhibit are many of them taken from paintings made on the spot by Mr. Waller, a nephew of Prof. Huxley, who certainly, by his faculty of close and accurate observation, does great credit to his distinguished relative. I have obtained from him corroboration of many facts which, though they might be expected to be noted by a chemist, or physicist, do not lie within the ordinary vocation of an artist.

On the other side of the mountains, subterranean heat is also manifested, and hot springs, accompanied by sulphur beds, are also found; but they have not been as thoroughly examined as those in the valley, and are represented as being less active.

Mr. Seymour, who has spent many months at Krisuvik, tells me that the sulphur beds on this side have been submerged by the clays washed down by the winter rains, and are, for the most part, now completely overgrown with grass. On digging beneath the surface, however, the sulphur earth is found to be only a short distance down, and on analysis the percentage of sulphur in one bed, 116 yards long, running up the side of the mountain, was discovered to range between 64 and 65·5. Here the earth was completely cold, and all further deposition of sulphur appeared to have ceased.



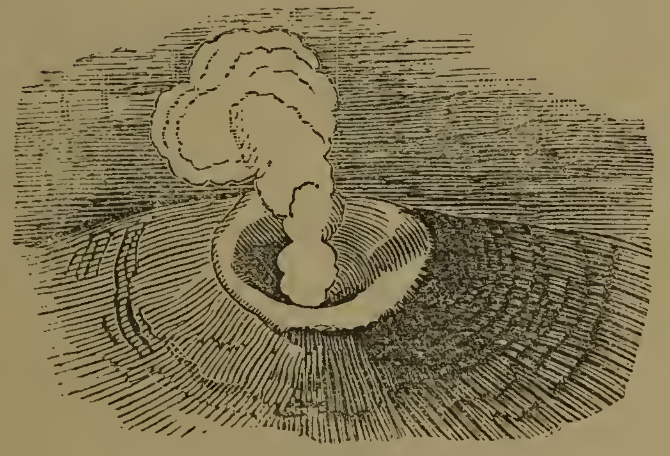
In the valley itself the springs are not always visible at the surface, being so completely covered by the earth, that it is only by piercing through the crust of indurated sulphur earth that their presence is discovered. Sometimes the explorer is made unpleasantly aware of the insecure nature of his footing by falling through, and thus opening up a fresh thermal spring. The late Sir William Hooker, when visiting this place, in endeavouring to escape a sudden gust of strongly odourous vapour, jumped into a mass of semi-liquid hot earth and sulphur—and but for his presence of mind, in throwing himself flat upon the ground, would have sunk to a considerable depth; as it was, the difficulty of extricating himself was very considerable.

The surface of the ground is covered in many places with a crust of 2 to 3 feet in depth of almost pure sulphur;

and in the valley, where the steam jets are protected from the extreme violence of the wind, the sulphur is deposited tolerably evenly over the whole surface. If it were not for the ever-varying direction of the wind, the sulphur would, Captain Forbes is of opinion, be precipitated in regular banks, but it hardly ever falls for twenty-four hours in one direction, the wind capriciously distributing the shower in every direction.

It has been suggested by those who wish to utilise the immense sulphur-producing power of this wonderful locality, that chambers should be erected (Sir George Mackenzie), or walls built up (Dr. Perkins), by which means, the force of the wind being broken, the sulphur would be quietly floated to the ground, instead of being carried up the sides of the hills, and thus more widely distributed.

With little variation the general appearance of the "solfataras," over the space of 25 miles along the volcanic diagonal, is much alike; an elevation about 2 feet high and 3 feet in diameter, which is composed of a dark bluish-black viscid clay, forms a complete circle round the mouth of a medium-sixed spring. The water is sometimes quiescent, and sunk about 2 feet within the aperture; at other times it is ejected, with great hissing and roaring noise, to the height of from 5 to 8 feet. At all times clouds of steam, strongly impregnated with sulphuretted hydrogen and sulphurous acid gas, issue from the orifice,



both of which, during an eruption of the water, are greatly augmented in quantity. From the dark-coloured and evelated margin of the fountain the yellow crust of crystallised sulphur extends a great distance in every direction. Columns of steam ascend from numberless points in the whole district, which are thus impregnated; and thus it is that, apparently for ages past, sulphur has been gradually heaped up in this locality till there are actually hills, which, as far as they have yet been pierced, show sulphur-earth to be their main constituents; hence they have acquired the name of the Sulphur Mountains.

The soil is of different colours, but most generally white. It is, in the vicinity of the springs, a viscid earth, less plastic than clay, and more readily broken.

When excavations are made into this earth, it is found to be composed of multitudinous layers, of different colours or shades of colour, each layer being quite distinctly divisible from those above and below it, though frequently no more than an inch or two in thickness.

It is much to be regretted that the good example set by Olafsen and Povelsen, of investigating the nature of the earth's crust round about the solfataras by piercing the soil, has not been more frequently carried out. In the summer of last year one of the suggestions which I made, for the instruction of an expedition to this place, was that boring implements should be taken out and extensively used; but accident prevented the necessary appliances being forthcoming at the right time. I believe, however, that one of the chief features in the expedition which is to set out in March, will be the thorough examination, to as great a depth as practicable, of the strata in various parts of the sulphur-valley.

The spring chosen by Olafsen and Povelsen as the subject of their first experiment, was one which had made its appearance since the preceding winter, and which was just beginning to be surrounded by other mud springs and jets of steam. The ground was still covered with lovely verdure, and charming flowers were abundant, even at the very verge of the cauldron of hideous hue and odour. A short distance from this opening they established their boring apparatus. The sequence of the layers was as follows:—

1. Three feet of reddish-brown earth, of a fatty consistence, of the ordinary temperature; at the bottom heat was perceptible to the touch.

2. Two feet of a firmer kind of earth, nearly the same in colour as the first layer, unctuous to the touch.

3. One foot of a lighter kind of soil.

4. Five feet of a very fine earth of different colours, the first 2 feet being veined red and yellow, with streaks of blue, green, red, and white intermingled. The lower portion of this earth was somewhat firmer than that which covered it. The heat of this thick bed was so great that the soil extracted by the auger could not be handled until it had been for some time exposed to the air.

5. One foot of a compact greyish-blue earth.

6. In tapping this bed, which was 4 feet 9 inches in thickness, and consequently at a depth of about 12 feet, water was first met with. It was found by comparison that the level of the water in the boiling mud spring coincided at this time with that of the water thus discovered. The heat was now very great, and a constant hissing and bubbling could be heard as proceeding from the bottom of the hole which had been made.

7. Nine inches of greyish-blue earth.

8. One foot six inches of a similar unctuous earth, containing many small white stones. This was the hottest layer of any yet pierced; the buzzing humming noise was now much louder than before.

9. Three feet of the same kind of clay, but much harder and more compact; this layer was also full of small, round, white stones.

10. Six inches of a violet-tinged earth, very greasy to the touch. In this bed the heat sensibly diminished.

11. One foot six inches of red and blue clay intermingled. The heat continued to diminish very fast.

12. One foot of reddish-looking clay, the temperature remaining about the same.

13. Six inches of yellow and red clay.

14. One foot of a greenish-coloured earth, much less coherent than the previous layers. Here the heat again began to increase.

15. One foot six inches of blue clay, filled with small pieces of white tufa. This bed was much hotter than either that above or that below it.

16. One foot three inches of soft blue clay.

17. Nine inches of an earth, easily pulverised when dry, which, whilst moist, was of a violet colour; on exposure to the air, however, this rapidly changed to a chocolate-brown. The heat was again augmented as the centre of the bed was approached.

At thirty-two feet the full length of the boring implements was used up; but, from the set of the country in the vicinity, the experimenters believed they were close upon basaltic rock, when the heat probably ceased.

In digging for the peculiar kind of browncoal which they call "surturbrand" (a kind of fuel very much resembling Irish bog-oak, which can be used for like purposes), the inhabitants frequently go as deep as 28 feet. They report that before reaching this depth they frequently pass through three or four beds of blue, yellow, and brown clay, and almost invariably find that the layers of blue clay are much hotter than any of the other strata.

A second trial of the soil was made in the neighbourhood of some recent springs, further to the east. The activity of the agencies at work here appeared to be greater than in the former case, and to have been longer in operation. The whole surface was thickly covered with sulphur in a finely-divided state; there was much gypsum, and a large efflorescence of feathery alum. Thousands of very minute holes were discoverable on close examination, through

which continuous jets of steam, sulphuretted hydrogen, and sulphurous acid gases were emitted.

An attempt was made to dig with spades, but the soil was found to be so hot, whilst the footing was at the same time so insecure, that it could not be persisted it. A spot some distance further off was therefore pitched upon, where the earth was firmer and colder. The borer pierced through 6 feet of blue clay with great facility, the lowest portion being extremely hot. After this depth the earth became rapidly softer; at the depth of 7 feet the same peculiar bubbling noise before noticed was heard. Continuing to bore, the bottom of the hole appeared to be in a state of ebullition, a boiling liquid being ejected in the narrow space around the handle of the auger with extraordinary violence, and, no sooner was the tool withdrawn, than a thick black fluid was ejected from the orifice to the height of several feet. A short time afterwards the jet ceased, the subterranean fire appeared to have expended its fury, but it soon re-commenced with re-doubled activity to dart forth fresh jets of steam and black muddy water, continuing to boil and dance with but slight intermission. It appeared, therefore, evident that the result of this experiment was the premature formation of a fresh hot spring, which would otherwise have been, perhaps, a considerable time in forcing its way to the surface.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.
(Chemical Section).

Ordinary Meeting, February 24th, 1873.

Mr. E. C. C. Stanford, F.C.S., Vice-President, in the Chair.

A paper was read on "*The Chemical History of Anthracene, and its Production from Coal-Tar,*" by Mr. R. F. Smith, Glenpark Chemical Works, Glasgow.

The author first devoted a considerable amount of attention to the nature and composition of coal-tar, incidentally tracing its history from before the Christian era down to the present time. Exact researches into the proximate composition of coal-tar were not attempted before 1848, the basic constituents being attaked first. Runge described carbolic, rosolic, and brunolic acids, Laurent confirming the existence of the first under the name of phenole. Hofmann, Fritzsche, Erdmann, Zinin, Anderson, Reichenbach, Young, Faraday, Mansfield, and other chemists each contributed to extend the knowledge of the composition of coal-tar; and many distinct chemical compounds were obtained from it. Proceeding to notice the chemistry of coal-tar as known at present, the author said that the substance varies much in specific gravity, some samples being as low as 1·00, and others as high as 1·15. The further away from retorts the lighter it is, the heaviest portion condensing first, while the condenser-tar, if it contains enough of oils to retain the naphthaline in solution, is very light. The more fluid the tar, the richer it is in naphtha. Crude naphtha is frequently found in considerable quantity, free from pitchy matter, in the "dreeps" between the purifiers and the gas-holder; and in the holder-tank it sometimes accumulates on the surface of the water. English tar generally contains less fluid matter than Scotch tar. In distilling the tar, water and naphtha are first separated, then the light oil, next ordinary creosote, or pitch oil, and sometimes there is obtained a further distillate, known as green oil, green grease, or heavy pitch oil, the residue in the boiler being pitch, which varies in hardness according to the amount of oil contained in it. The following is the average composition of coal-tar, as determined by the experience of many years in an English tar distillery:—

One ton of tar, sp. gr. 1·145 = 195·7 galls., yielded—

Ammonia water ..	3 galls. per ton.
First runnings	6 ,, ,,
Light oil	21½ ,, ,,
Creosote, or pitch oil	66 ,, ,,
Pitch	11 cwts. 3 qrs.

The first runnings, rectified, yielded—

48 per cent of	50 per cent benzol	= 2·88	galls. per ton of tar.
20 ,,	solvent naphtha	= 1·20	,, ,,
5½ ,,	burning naphtha	= 0·33	,, ,,
11½ ,,	"tailings"	= 0·69	,, ,,
15 ,,	loss		

The light oil yielded—

7 per cent of	solvent naphtha	= 1·49	galls. per ton of tar.
15 ,,	burning ,,	= 3·18	,, ,,
75 ,,	pitch oil	= 16·00	,, ,,

Or, in all, 1 ton of tar yielded—

50 per cent of benzole	= 2·88 galls.
Solvent naphtha	= 2·69 ,,
Burning ,,	= 3·51 ,,
Creosote oil	= 83·00 ,,
Ammonia water	= 3·00 ,,
Pitch	= 11 cwts. 3 qrs.

In the second part of his paper the author treated of anthracene, commencing with the discovery by Dumas and Laurent, in 1832 of a hydrocarbon, to which they gave the formula $C_{15}H_{12}$, and applied the name paranaphthaline. On making further examination, Laurent named the body anthracene. Fritzsche, in 1857, discovered a substance very closely resembling Dumas and Laurent's compound, and he assigned $C_{14}H_{10}$ as its formula. Anderson, in 1862, described a hydrocarbon of the same formula under the name of anthracene, although many of his observations differed essentially from those made by Laurent. In 1866, Limpricht synthetically produced anthracene by heating benzyl chloride with water to 180° C.; and in the same year Berthelot showed that it was obtainable by the action of heat on various simple hydrocarbons, such as toluol, a mixture of styrol and benzol, or a mixture of benzol and ethylene. He also confirmed Anderson's observations. Graebe and Liebermann, in 1868, obtained from alizarine a hydrocarbon posessing the same properties and composition as Anderson's anthracene. After giving an outline of the view generally taken of the constitution of anthracene, and showing its relation to benzol and other members of the aromatic group of hydrocarbons, Mr. Smith described the various methods by which anthracene is produced on the large scale. Probably not more than 10 tons of the commercial anthracene of 95 per cent has yet been produced in all the Scotch tar distilleries together, but in England the manufacture is proceeding on a more extensive scale, and as knowledge extends, additional works are taking it in hand. The great practical difficulty in the way of distilling the pitch for its contained anthracene is to find a proper arrangement of flues for the regulation of the heat. What is wanted is a sharp, quickly applied heat, sufficiently powerful to coke the pitch in a proper manner, and yet not strong enough to melt the iron walls of the retorts. Clay retorts have been tried, but they do not appear to answer, owing to the intermittent nature of the heat required, partial cooling being necessary after each charge, to allow the coke to part properly from the retort. Ordinary coke ovens with condensing arrangements do not suit, as part of the oil is burnt; the practical difficulties will, however, be overcome, and in many localities retorts for coking pitch have been in regular use for years. In working a charge, it is found that, under ordinary circumstances, all volatile matters can be driven off in about six hours; but the fire is still maintained a few hours longer, to get the coke hard enough. After cooling for some time, the coke is withdrawn and drenched with water. The first distillates in the operation are hydrogen gas and water vapour, with a little oil contain-

ing naphthalene, sp. gr. 0·97. When two-thirds of the oil has passed over coking commences, and towards the end of the operation permanent gases and hydrocarbons of low boiling-points appear. Finally, there is a red-yellow resinous sublimate, and the process is finished. The following is the result :—

Anthracenic oil, chrysen and pyren oil, and sublimed resin..	27	to 30 per cent.
Gases, steam, and about 0·2 per cent light oils	25	„ 18 „
Coke	48	„ 52 „
	100	100

The anthracene oil is soluble to the extent of 3 per cent in caustic soda, the dissolved matter yielding, on distillation, a red resinous body whose nature is at present unknown. The anthracene and chrysen oils are all mixed together and sent to the colour-makers, who subject the mixture to distillation, taking care to stop when the yellow matters begin to appear, the anthracene being separated in the usual way. The author described the properties of pure anthracene, its compounds, and its hydrogen and other derivatives, such as anthrachinon, the bromides of anthracene and others, and explained how they are prepared. He then passed on to show the chemical relationship between those derivatives and the alizarine of madder-root, and gave a short sketch of the various patents taken out by Graebe and Liebermann, Caro, Perkin and Dale, and Schorlemmer, for the manufacture of artificial alizarine, concluding with a brief notice of the industry which is now established in connection with it, both in this country and on the continent of Europe.

A short discussion followed, and the author was complimented for his very comprehensive and interesting paper.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, March 3rd, 1873.

Sir Henry Holland, Bart., M.D., D.C.L., President, in the Chair.

Prof. Tyndall was present for the first time at a monthly meeting since his return from America, and on the motion of Sir Frederick Pollock, Bart., seconded by W. Pole, Esq., F.R.S., the following resolution was unanimously carried :—

Resolved,—That the warmest congratulations of the Members of the Royal Institution be offered to their Professor of Natural Philosophy upon his arrival in England from the United States of America, in which, upon the invitation of the most eminent scientific men of America, he has been recently delivering a series of Lectures unexampled for the interest they have created in that country, and the large and distinguished audiences who have been attracted to them.

The Members of the Royal Institution rejoice that the people of America have shared in the advantages of Professor Tyndall's teaching and illustrations of those sciences which have been so greatly advanced by the labours of his predecessors, and by his own, in the laboratories of the Royal Institution.

They receive and welcome him, on his return to what they are proud to be able to designate as his own scientific home, with satisfaction and delight, and wish him all continued health and prosperity.

The Members of the Royal Institution have also to thank Professor Tyndall for his generous gift to the Institution of the splendid and extensive apparatus employed by him in his Lectures in America, and congratulate him on the liberal spirit, and the love of science, which has led him to appropriate the profits of his Lectures in the United States to the establishment of a fund to assist the scientific studies of young Americans in Europe.

CHEMICO-AGRICULTURAL SOCIETY OF ULSTER.

On the 7th inst., the usual monthly meeting of this Society was held in the Laboratory, Upper Arthur Street. Mr. John Sharman Crawford, D.L., presided; and amongst those present were—Mr. Wm. Charley, J.P.; Dr. Knox; Rev. Edmund M'Clure; Messrs. Samuel M'Causland, J.P.; W. Gray; F. Hodges, Chemical Assistant; J. L. Turtle; G. Glover, F.C.S. Ireland; Dr. Hodges, &c.

Analysis of Water.

Dr. Hodges said that the examination of the several specimens of water, in addition to those formerly reported, had been made. Among these was a water from Whiteabbey, which was found contaminated by sewage matters. A most interesting discovery of a water strongly impregnated with iron had been brought under his notice by the Rev. James O'Laverty, P.P. The water was contained in a pit whence gravel had been taken, in the hills above the town of Holywood, and Mr. O'Laverty kindly accompanied his son to the locality, and assisted him in obtaining specimens. It had a strong chalybeate taste, and was bright and sparkling, and an analysis of it, made by his son, showed it to contain iron equal to 14 grs. of peroxide of iron per gallon. He was not aware of any water in Ireland which contained so large an amount of iron. At present the water was diluted by the entrance of surface water, and it would be desirable to exclude this water before making a complete analysis.

Carbolic Acid as a Remedy in Cattle Disease.

Dr. Hodges read a letter received from Mr. Bloomfield, steward to Sir Edmund Macnaghten, Bart. :—

"To Professor Hodges, Belfast.—Sir, I consider you would confer a great benefit on the farmers of Ulster if you would make known your opinion as to the best mode of administering carbolic acid to young cattle suffering under a very painful and sometimes fatal disorder. I am induced to apply to you, having read an article in the last number of the *Journal of the Chemico-Agricultural Society*, wherein it is stated—'Destroying septic germs and preventing their formation, the administration of carbolic acid is evidently indicated in those diseases in which tissue change is unduly violent." As land-steward to Sir Edmund Macnaghten, Bart., I have been in the habit for nine years past of rearing annually from twenty-five to thirty calves. On being turned out to grass, and milk withdrawn from them, they have been always attacked, except in the year 1870, by a severe and infectious cough about the first week in August. None of them escaped it. Those in the lowest condition, of course, were the greatest sufferers, and several died. There need be no doubt but the seat of the complaint was the windpipe, and that from thence it passed on to the lungs. In every case where there was death, and an examination took place afterwards, the animal appeared to have been suffocated by an accumulation of minute worms, which were found in such quantities as completely to prevent breathing. The cough was only an effort to dislodge the intruders. How their entrance was made was uncertain; but the absence of them in the one year (1870) out of nine, pasture and other things having been the same in all years, would indicate that the origin of the disease was in some degree, if not entirely, owing to atmospheric influence. Many farmers in this part of the country have sustained similar losses. If you think the pest can be prevented or extirpated by carbolic acid, I would request you to state the mode in which it ought to be administered, and the quantity to be given; whether internally, or by outward application to the mouth and nostrils, or by inhalation?—I am, Sir, your obedient servant, William Broomfield, Dundarave, Bushmills, Jan. 20, 1873."

In reference to the mode of administering carbolic acid, the mixture described in the last number of our *Journal*

might be employed. It may also be dissolved in 30 parts of water, and applied to the throat by means of a piece of sponge tied on a rod; but, probably, the best mode of using it, in cases like those described by Mr. Bloomfield, would be to mix it with 50 parts of water, and to apply it in the form of spray, by means of the little spray-producing apparatus used for distributing perfumes. Dr. Hodges exhibited the spray-producer, and explained the mode of using it.

The New Patent Safety Cheque.

Dr. Hodges exhibited a specimen of the form in which his patented cheque was prepared for the use of the Ulster Bank. He had forwarded specimens of the cheques to several distinguished chemists, and he had the gratification of receiving a letter from his friend and former teacher, Baron Von Liebig, who remarked that "the idea of employing the prepared ink, as suggested, was entirely new and excellent, and rendered the removal of writing from the cheque without detection impossible."

Oil from Shale.

Dr. Hodges said that the examination of a sample of shale had been made for R. M. Dalway, Esq., M.P., which, from the large amount of oil obtained from it, promised to yield profitable results. It was desirable that attention should be directed to the examination of the shales which are known to exist in several places in the north of Ireland. He (Dr. Hodges) regretted that he was not able to report so favourably on a specimen of rock forwarded from the neighbourhood of Toome Bridge, the bright sparkling lustre of which had led its discoverer to suppose it to contain some valuable metal. It was, however, merely a piece of crumbling mica slate, containing no precious ingredient. Pieces of rotten micaceous rock had repeatedly been sent to the Laboratory, under the belief that they were ores either of copper or gold.

The Ballintoy Coal Mine.

Mr. F. Hodges said—I beg to call the attention of the meeting to a remarkable substance which I have lately been engaged in investigating. It is obtained from the Ballintoy coal mine, where it lies just above the lignite, It resembles, as you can perceive, hardened clay in appearance; and, on being subjected to analysis, it was proved to be saturated with a very considerable quantity of hydrocarbons. This analysis, for two reasons, I consider to be of very great importance. It points, first, to the probable formation of the bed of lignite, over which it lies, by heat. Secondly, if it turned out on a further examination, to contain a workable quantity of the hydrocarbons, it would tend greatly towards the opening up of the mineral resources of the north of Ireland.

Mr. Wm. Gray said that he had brought the specimen in question from Ballintoy to have it examined by Mr. Hodges. There were several other beds of shale in the County Antrim that might be reasonably expected to yield a large quantity of oil. There were large beds in the neighbourhood of Whitehead, and the time had come when matters of this sort must be inquired into—(Hear, hear)—and it was only through a society like this that these things could be examined. He had, however, found that people were more anxious to expend money on a hopeless project than upon one which gave reasonable hope of success.

Dr. Hodges said that some years ago a gentleman in the neighbourhood of Donaghadee took it into his head that he had discovered coal in the neighbourhood. He (Dr. Hodges) examined the specimen sent him, and found that it was not coal at all; but the gentlemen was quite displeased, and declared that he was certain it was coal, only it wouldn't burn—(Laughter).

The Rev. Mr. M'Clure said that on the property of Mr. Nicholas Grimshaw, on Collin Mountain, a well was lately sunk, in which water of a peculiar property was found. It appears to contain a large quantity of magnesia, and is purgative in its properties.

Some conversation followed as to the medicinal springs of Ireland, especially the one at Swanlinbar, and the one at Lisdoonvarna, County Clare. The latter has been recommended by the faculty in Dublin for certain forms of disease, and the former is said to be somewhat similar to the famous spring at Harrogate.

CORRESPONDENCE.

DECOMPOSITION OF SULPHURIC ACID BY ZINC.

To the Editor of the Chemical News.

Sir,—In your correspondence column (Chemical News, vol. xxvi., p. 117) the Rev. H. Highton combats the opinion that the evolution of sulphuretted hydrogen from carbon connected with zinc, in a cell charged with sulphuric acid (first observed by him), is due to the contamination of the carbon used by iron sulphides; and he suggests, in explanation of this evolution, that the sulphuric acid is decomposed under these circumstances, and the gas in question thus formed.

Neither of these views appearing tenable to me, I beg to offer a few remarks thereon.

The evolution of gas instanced admits, I think, of adequate explanation in manner as follows, if we assume only this—that the carbon used in the experiments referred to had had some little contact with the atmosphere prior to use. In such a case, as is well known, the carbon will absorb a small quantity of sulphuretted hydrogen, and this *should* be evolved as such from its surface when the carbon is connected voltaically with zinc in sulphuric acid, precisely in the same manner that metallic sulphides generally—when similarly connected with zinc in the same acid—give off this gas at their surfaces, as shown in a paper of mine (Chemical News, vol. xxiii., p. 291).

In support of this, experiment will show that the gas in question does not appear if carbon free from sulphur is used; but, on the other hand, if it is sulphurised (*i. e.*, had contact with HS), then thoroughly washed, and connected with zinc in hydrochloric acid (pure), an abundance of HS is discharged from the carbon. Coke or graphite may be nearly or quite purified from sulphur in this manner, and I would recommend the process to those desirous of effecting this.

That carbon as *coke graphite* is a true metal appears, no doubt, highly probable to those chemists who consider its conducting power for heat and electricity. I can therefore see nothing improper in viewing the absorption of sulphuretted hydrogen by this substance as a chemical act, resulting in the production of an inferior sulphide analogous to the sulphuretted gold and platina I have described in your periodical, and so capable of disintegration by the same means as are generally serviceable for that of other metallic sulphides.—I am, &c.,

William Skey.

Wellington, New Zealand.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts o all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 24, 1873.

Contains the following original memoirs more particularly relating to chemistry:—

Researches on the Gases Dissolved in Molten Cast-Iron, Steel, and Wrought-Iron at Welding Heat.—L. Troost and P. Hautefeuille.—The first instalment of a monograph treating on the nature and mode of absorption of gases (the same as those present in the reduction zone of the blast furnaces) by the metals alluded to when kept at high temperatures, and free from contact of air. In this portion of the essay, the authors particularly call attention to the gradual absorption of silicium by these metals, due to the action (corrosion) of the metals upon the silica of the crucibles—made of *gaize*, nearly pure silica, a mineral largely met with in France—when kept, viz., the metals in molten state, under strong pressure by means of oxide of carbon.

Combination of Sugar with Chloride of Potassium.—Ch. Violette.—Cane sugar forms with chloride of potassium a well-defined crystalline compound which is crystallographically described, while its chemical composition is $C_{12}H_{20}KClO_{11}$; the formula of the sugar is, therefore, $C_{12}H_{22}O_{11}$, and the combination of sugar and chloride of sodium is $C_{12}H_{20}NaClO_{11}$. This compound was discovered years ago by Peligot. The sucrate of chloride of potassium is not deliquescent.

Solidification of Mixtures of Water and Acetic Acid.—E. Grimaux.—This paper, illustrated by a diagram, treats on the point of congelation of mixtures of water and acetic acid in various proportions. The pure acid employed in these researches became solid at 14·4°, and contains, according to Rüderdorff's tables, 1·25 per cent of water. A lengthy tabulated form containing the results of the experiments is added here. A mixture of 83·79 water and 16·21 acetic acid solidifies at 5·43°, the average of three determinations.

Sensitiveness of the Bunsen Gas-Burner Flame for Boracic Acid.—M. Bidaud.—The author minutely describes a series of results of experiments, from which it appears that when the flame is, without the use of blowpipe, brought near to a piece of porcelain whereon a minute crystal of boracic acid is placed, the flame is intensely green-coloured. Even with a solution only containing 9-10ths milligrm., of the acid the colouration is strongly marked. By accurate experiments the author ascertained that the colouration was *not* due to the combustion of the copper of the alloy (brass) of the tube from which the flame issues.

Action of Zinc upon Chloride of Acetyl.—D. Tommassi and G. Quesneville.—After briefly referring to the late Gerhardt's researches on this subject, the authors state that they prepared the acetylide—as they call the result of the reaction alluded to—which is an amorphous, yellowish-brown coloured substance, soluble in alcohol, ether, chloroform, hydrochloric, fuming nitric, and anhydrous acetic acids, burning when ignited upon platinum foil with a bright flame. Dried at 100° and analysed, the composition of this body is found to be $C_{16}H_{18}O_4$. The reactions by which this body is formed are elucidated by a large number of complex formulæ.

Analysis of Agaricus Fœtens. — Dr. Sacc. — This poisonous mushroom, gathered in dry weather in a forest under oak trees, was found to contain percentically—Water, 67·20; mannite, 0·60; pectic acid, 0·09; fibrine, 4·66; bassorine, 1·55; woody fibre, 20·09; fatty and colouring matter, 0·68; ash, 5·13; total, 100·00.

Valuation of the Saccharine Matter in Beetroots.—E. Monnier.—The author states that in order to ascertain the quantity of absolutely uncrystallisable sugar which beetroot will yield, it is required to estimate the ash (saline matter) very accurately, and to multiply the figure so obtained by 4 or 5, the latter being the highest coefficient.

Rendering Ladies' Dresses and other Wearing Apparel Unimflammable.—M. Trémaux.—The author advocates the use of mixtures of sulphate of potassa and alum in solution, to be concentrated according to the nature of the fabric it is intended to render—not as is sometimes erroneously supposed incombustible, but uninflammable.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, 1873.

Contains the following original memoirs and papers:—

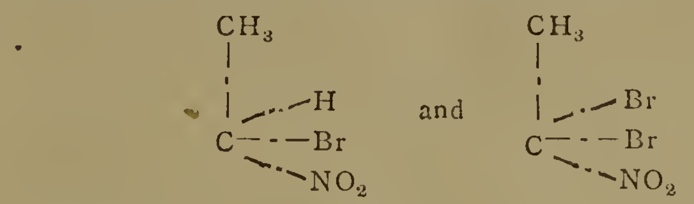
The Atomic Weight of the Cerium Metals, and on the Salts of the Protoperoxide (Ceroxydoxydul) of Cerium.—C. Rammelsberg.—This monograph, elucidated by a large number of complex formulæ, treats on the composition of the salts of the protoperoxide of cerium, Ce_3O_4, but according to Mendelejeff (who takes the equivalents of cerium at 138, two-thirds more than the former equivalents, viz., 92) CeO_2, while the protoxide of cerium then becomes Ce_2O_3, formerly CeO. The salts alluded to are described at length, and the essay contains an exhaustive discussion on the atomic weights of the other metals of the cerium group, viz., didymium, lanthanum, yttrium, &c.

Spontaneously Inflammable Phosphuretted Hydrogen Obtained from Iodphosphonium.—C. Rammelsberg.—The author briefly observes that the gas obtained from iodphosphonium by the action of caustic potassa is not spontaneously inflammable (see *Ber. d. Deutsch. Chem. Gesells.*, 1871, p. 200), but becomes so while being evolved, and this is confirmed by an observation made by H. Rose (*Pogg. Ann.*, 24, p. 345).

Sensitiveness for Light of the Haloid Salts of Silver when Developed (in Photographic Sense) by Alkalies.—H. Vogel.—The main features of this essay may be summarised as follows:—The photographic sensitiveness of the chloride. Bromide and iodide of silver is not simply affected by the intensity of the light, but is essentially modified by the method of development. For acid developers and white light the scale is—Iodide of silver>bromide of silver>chloride of silver (the sign > signifies here "more sensitive than"). For alkaline developers—Bromide>chloride>iodide. With coloured light (that is to say when violet and indigo are wanting) and alkaline developers the same scale holds good. For acid developers and dry plates the scale is iodobromide (iodbromsilber)>bromide>iodide of silver. With the wet process and acid developers the most sensitive mixture is (5AgI+1AgBr); but with the dry process a mixture rich in bromide answers best. The method of preparation does not, according to my researches, affect the sensitiveness of the three haloid salts of silver alluded to.

Constitution of Hyperiodic Acid.—A. Basarow.—The contents of this memoir bear chiefly upon certain corrections which the author thinks are required to be made in Dr. Thomsen's essay on hyperiodic acid, recently published in *Berichte der Deutschen*, vol. vi., p. 2; and further we meet here with the author's theoretical views on the constitution of the acid.

The Nitro Compounds of the Fatty Series (Fifth Part).—V. Meyer and C. Wurster.—This essay is divided into the following sections:—Monobrom-nitroethan; dibrom-nitroethan. The first-named is an oily liquid, boiling at from 145° to 148° without decomposition; formula $C_2H_4BrNO_2$. This body is acid, which forms with some of the alkalies crystalline salts, but in most instances a further decomposition sets in. The dibrom-nitroethan has not acid properties, is an oily fluid boiling at between 162° and 164°; the constitutional formulæ of the bodies alluded to are respectively—



Contribution to our Knowledge on the Detection of Digitaline and Atropine.—H. Brunner.—Reserved for translation.

Conversion of Glycerine into Aceton.—O. Lange.—In the first part of this paper the author refers to the labours of Carius (*Ann. Chem. Pharm.*, 155, p. 35) on this subject, and then relates at length the results of his experiments for converting crystalline dichlorbromaceton into aceton by the action of granulated zinc and some sulphuric acid; the boiling-point of the aceton is 58°. This reaction, however, is very slow; it is elucidated by the following formula:—

$$C_3H_2Cl_2Br_2O+H_{10}=C_3H_7Br+BrH+2ClH+H_2O.$$

The aceton was, in order to ascertain its identity, combined with bisulphite of soda, the composition of that combination led to the formula $C_3H_6O.SNaHO_3$.

A new Body of the Same Composition as Hydrocyanic Acid.—O. Lange.—This essay records at length the results of an investigation of the slow reaction (continued for several months) of epichlorhydrine and hydrocyanic-anhydride placed together in equal parts in sealed tubes, and exposed to sunlight. After a lengthy process of purification, the author obtained a crystalline body, readily soluble in water and in boiling alcohol, but difficultly soluble in ether. When heated by itself it detonates, giving off a smell of hydrocyanic acid, while by being heated with water the substance is decomposed, depositing a humus-like substance. The formula of this new body is CNH; percentically, C, 44·44; H, 3·70; N, 51·8.

The Systematic (Systematik) of Inorganic Chemistry.—L. Meyer.—Elucidated by a large number of formulæ and tables. This essay, bearing upon the theory of chemistry, is not suited for abstraction, notwithstanding its high intrinsic value.

Activity of Oxygen in the Processes of Slow Oxidation.—H. Fudakowski.—Reserved for translation.

Chloral and Acetonitrile.—H. Hübner.—After briefly referring to Bayer's researches on the reaction of chloral, benzol, and sulphuric acid, resulting in the formation of the compound $C(C_6H_5)2H.CCl_3$, the author describes at length, and elucidates, by a series of complex formulæ, the results of his researches on the reaction between chloral and acetonitrile, whereby a peculiar amide of a bibasic chlorinated acid is obtained.

Action of Sulphocyanates upon Benzoic Acid.—A. Kekulé. This essay reviews chiefly the results of the researches on this subject obtained by Pfankuch (it is especially pointed out that the benzacrylic acid obtained by this author, for which see *Journ. f. Prakt. Chem.*, N.F., vol. xi., p. 97, does not exist), Kachler, Williams, Letts, Purper, and others.

Action of Cyanide of Potassium upon Chloral, and on a New Method of Preparing Dichloracetic Acid.—O. Wallach.—At great length the author describes, first, the method of preparation of chloral-cyanhydrate, obtained by the action of 1 molecule of cyanide of potassium upon 1 molecule of chloral-hydrate in small quantity; while the reaction yields, in large quantity, dichloracetic acid ether, which, by treatment with HCl at 150° in a sealed tube, is readily converted into chlorethyl and dichloracetic acid, which may thus be readily prepared.

New Series of Aromatic Hydrocarbons.—Th. Zincke.—The third instalment of a monograph on this subject. This portion treats on the hydrocarbons formed by the action of zinc powder upon a mixture of benzol and benzyl-chloride.

On Griess's Phenylen-diamine, and on Bibrom-benzol.—Th. Zincke and Fr. Sinteris.—The authors state, in the first place, that the brom-nitrobenzol, fusing at 38°, may be readily converted into Griess's phenylen-diamine by first converting the aforesaid brom-nitrobenzol into the thereto corresponding nitraniline, and next treating that with tin and hydrochloric acid. So obtained, the

phenylen-diamine was a crystalline body, fusing at 99°, soluble in ether and chloroform, and yielding, with perchloride of iron, the reaction alluded to by Griess. The second portion of this lengthy essay treats on bibrombenzol, more especially on its position, viz., whether it is 1·4 or not.

Synthesis of Phenanthren.—C. Graebe.—Elucidated by a series of complex formulæ, exhibiting the synthetical formation of phenanthren—

$$\begin{array}{l} C_6H_4 - - CH \\ \;|\qquad\quad \| \\ C_6H - - CH \end{array}$$

Chemical Nature of Staurolithe.—C. Rammelsberg.—After first quoting the results of former researches of this mineral, the author states that staurolithe from Gotthardt consists, in 100 parts, of—Titanic acid, 0·56; silica, 29·46; alumina, 52·29; protoxide of iron, 13·42; magnesia, 2·29; water, 1·42; total, 99·42. Simplest formula—

$$H_2R_3Al_6Si_6O_{34}=R_{22}Si_3O_{17}.$$

Synthesis of Tyrosine.—A. Ladenburg.—Illustrated by woodcuts. Treats on Barth's experiments made with tyrosine, and on its rational formula, and on its synthetical preparation.

Constitution of the Chlorophenols, the Chloronitrophenols, and the Nitrophenols.—A. Faust.—Elucidated by lengthy and complex formulæ, as well as several tables. This memoir treats exhaustively on—Metachlorpara-nitrophenol, fusing-point 110°; metachlormeta-nitrophenol, fusion-point 70°; metachloroparanitrometa-nitrophenol, fusing at 110° to 111°; dimetachloropara-nitrophenol, fusing at 125°; parachlorometa-nitrophenol, fusing at 86° to 87°; parachlorodimeta-nitrophenol, fusing at 81°; parachlorometanitrometachlorophenol, fusing at 121° to 122°.

Action of Zinc upon Mixtures of the Aromatic Haloid Combinations and AromaticHydrocarbons.—Th. Zincke.

Direct Formation of the Aromatic Amido-Derivatives.—H. Salkowski.—The conclusion of an essay on this subject.

Les Mondes, February 27, 1873.

Crucibles of Great Resistance.—M. Lemagnent.—Without entering into particulars concerning the mode of manufacture, or the nature and properties of the ceramic paste of the crucibles supplied by the author, it appears that by practical experience these vessels are superior to any other, bearing as they do without any great deterioration, from 25 to 30 castings. The authorities of the French naval dockyard foundries speak in very high terms of these crucibles.

Barometrical Table for the use of those who Ascend in Air-Balloons.—M. de Lagorge, C.E.—The tabulated form here published indicates for from 100 to 100 metres, viz., 100, 200, 300, and so on to 10,000, the reading of the barometer in millimetres corresponding to these altitudes. This table may readily also serve for determining the height of mountains.

La Revue Scientifique de la France et de l'Etranger, March 1, 1873.

Contains no papers relating to chemistry, but attention is called to the following papers:—

Classification of the Human Races.—Baron D'Omalius d'Halloy.

Unity of the Human Species.—Professor Quetelet.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 243, March, 1873.

Contains the following original papers relating to chemistry and collateral subjects:—

Reports on the Ready-Made and Mixed Vitrifiable Pigments for Staining Glass and Porcelain, as Prepared by Lacroix.—J. Salvetat.—The contents of this paper relate to the mode of preparation of the mineral pigments used in staining glass and porcelain, and mixed ready for immediate use, being preserved in tin tubes akin to those used for artists' colours.

Presence of Phosphorus (Phosphoric Acid) in the Ashes of Coals and Coke.—Le Chatelier and L. Durand Claye.—The contents of this paper, elucidated by numerous quotations of results of analysis of coal-ash published in various treatises on metallurgy and on geology and chemistry, bear more particularly upon the fact that by the presence of phosphoric acid, which varies in quantity from 0·20 to even 3·01 per cent. in coal-ash, phosphorus is introduced into crude cast-iron, as well as into the iron castings made in foundries.

The Great Salt-Mines of Poland; and the Gypsum-, Sulphur-, and Petroleum-Bearing Strata of that Country and Galicia.—E. Heurteau.—The first instalment of an exhaustive report on these matters as the result of a lengthy visit to the localities alluded to.

Although not belonging to chemistry attention is called to the following memoir:—

Report on Donnet's Improved Machinery for Forcing into the Soil the Iron Tubes used for the So-called Norton or Tube Wells.—M. Tresca.—Illustrated with engravings.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

495. W. C. Nangle, Bull Point, near Devonport, Devon, "A new or improved composition or paint, to be used for coating metal and other substances."

505. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of chlorine."—Petitions recorded February 11, 1873.

511. S. W. Maquay, Dublin, "An improved process to be employed in the manufacture of manures, and machinery or apparatus therefor."

513. H. Campbell, Queen Anne Street, Middlesex, "Improvements in the manufacture of manure, and apparatus therefor."—Petitions recorded February 12, 1873.

539. J. Noad, Hackney Wick, Middlesex, "Improvements in the manufacture of sulphurated lead, in apparatus therefor, and in its application to various useful purposes."—Petition recorded February 13, 1873.

547. J. G. Willans, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."

551. D. Hutchison, Mile End, and W. G. Bridges, Stepney, Middlesex, "An improved composition for removing and preventing incrustation in boilers."—Petitions recorded February 14, 1873.

562. T. A. Rochussen, King William Street, London, "Improvements in the manufacture of iron and steel, and in apparatus employed therein."—A communication from R. Daelen, Neuss, Germany.

567. R. Cockshott, Bradford, Yorkshire, "A new or improved oil or lubricant."

569. J. Patison, Airdrie, Lanarkshire, N.B., "Improvements in the destructive distillation of coal and shale for the production of illuminating gas, fuel, and oil, and other products therefrom, and in the apparatus therefor."

570. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the deodorisation of excreta, and in the manufacture of manures therefrom."—Petitions recorded February 15, 1873.

588. A. J. H. Hutchings, Bristol, "Improvements in spicing and preparing malt or distilled vinegar, rendering the same better suited for pickling purposes."—Petition recorded February 17, 1873.

599. C. W. Sutton, Stowmarket, Suffolk, "Improved combinations of ingredients for removing acidity from ales, beers, porters, wines, &c., and also to preserve them from acidity."

607. G. Noble, Woodford Bridge, Essex, "An improved method of treating fibrous materials for the manufacture of pulp for paper."—Petitions recorded February 18, 1873.

642. W. G. Martin and R. E. R. Martin, Hemingstone Hall, Suffolk, "Improvements in the manufacture of artificial fuel."—Petition recorded February 20, 1873.

NOTICES TO PROCEED.

3040. P. Maccallum, Dunfermline, N.B., "A new or improved artificial fuel."—Petition recorded October 15, 1872.

3142. A. V. Newton, Chancery Lane, Middlesex, "Improvements in furnaces for burning sulphurous ores."—A communication from K. Walter, Augsburg, Bavaria.—Petition recorded October 23, 1872.

3194. T. Colby, Dunstable, Bedfordshire, and J. E. Poynter, Glasgow, N.B., "Improvements in obtaining caustic baryta."—Petition recorded October 28, 1872.

3412. G. Alsing, Preston, Lancashire, "Certain improvements in the treatment of night-soil and other refuse matter."—Petition recorded November 15, 1872.

274. R. H. Patterson, Hammersmith, Middlesex, "Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose."—Petition recorded January 23, 1873.

370. J. Richardson and J. Watson, Gateshead-upon-Tyne, Durham, "Improvements in puddling and rolling-mill furnaces."—Petition recorded January 30, 1873.

429. J. P. Sharp, Birmingham, "Improvements in the manufacture of steel, and in case-hardening, or partially converting iron into steel."—Petition recorded February 5, 1873.

458. A. Lafargue, Westbourne Park, Middlesex, "Improvements in the production of gas or vapour from hydrocarbon oils or combinations thereof with other matters, and in means or apparatus employed in utilising the same."—Petition recorded February 7, 1873.

PATENTS SEALED.

2573. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of hydrochloric acid, and in apparatus employed therein."—Dated August 29, 1872.

2596. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of salt."—Dated August 31, 1872.

2630. J. W. Pollard, Mincing Lane, J. Schofield, Mark Lane, and A. Butel, Merchant Street, Bow, Middlesex, "Improvements in the treatment of spent oxides of iron for the purpose of extracting cyanides."—Dated September 4, 1872.

2649. W. Meister, E. Lucius, and A. Brüning, Hoechst, near Frankfort-on-the-Main, Germany, "Improvements in the manufacture of colouring matter suitable for dyeing and printing."—Dated September 6, 1872.

2790. R. Stone, Liverpool, "An improved artificial fuel."—Dated September 28, 1872.

2801. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Dated September 21, 1872.

3192. E. P. H. Vaughan, F.C.S., Chancery Lane, Middlesex, "Improvements in the mode of, and apparatus for, generating gas for lighting and heating purposes."—A communication from E. A. Dubois, Paris.—Dated October 28, 1872.

3968. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of steel, and in apparatus employed for this purpose."—A communication from T. R. Scowden, Cincinnati, U.S.A.—Dated December 31, 1872.

MEETINGS FOR THE WEEK.

Monday, March 10th.—Medical, 8.
—— Royal Geographical, 8½.
—— London Institution, 4.
Tuesday, 11th.—Civil Engineers, 8.
—— Photographic, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
Wednesday, 12th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 13th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
Friday, 14th.—Royal Institution, 9. Prof. Allman, "On Coral-Reefs and their Architects."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
Saturday, 15th.—Royal Institution, 3. Prof. W. K. Clifford, M.A., "On the Philosophy of the Pure Sciences."

TO CORRESPONDENTS.

A Bookkeeper.—See article on "Luminous Fountains," vol. xxi., p. 231.

M. and S.—You will find particulars in recent numbers of the Chemical News, under "Chemical Notices from Foreign Sources."

Volta.—(1). Boiled linseed oil. (2). Borate of manganese with raw linseed oil. (3). At the manufactory or of the agent.

Student.—Your letter has been sent to the proper quarter.

S. A. S.—We have none at present.

A Subscriber.—(1). It is in French. (2). Probably.

Alpha.—(1). Read Mr. Lowthian Bell's work (Chemical News, vol. xxiii., p. 104). (2). Yes, any bookseller will get it.

P. J.—Yes, but it is rare.

R. F.—Advertise for the information.

A. Esilman.—In our next.

BOOKS RECEIVED.

A Manual of Metallurgy. By George Hogarth Makins, M.R.C.S., F.C.S. Second edition. Ellis and White.

Proceedings of the American Pharmaceutical Association; Twentieth Annual Meeting. Philadelphia: Sherman and Co.

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Dormoy's Patent Rabble for Black Ash Making, &c.
Decomposing Pans.
Gas Producers for Heating Pans.
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THE CHEMICAL NEWS.

Vol. XXVII. No. 694.

ON THE VAPOUR-DENSITY OF POTASSIUM.

By JAMES DEWAR and WILLIAM DITTMAR.

Preliminary Notice.*

Since the elaborate experiments of Deville and Troost on the vapour-densities of substances at high temperatures, little has been added to chemical science in this field of research. Doubtless this is in great part owing to the difficulty of any *one* student manipulating the complex apparatus necessary for the execution of the experiments. But the operations are greatly increased in difficulty, when we select bodies that are readily inflammable in air and attack with facility glass and porcelain at the high temperatures to which they are exposed. This is the reason why the molecular weights of a most important class of elementary bodies, viz., the *Alkali-metals* (although these are volatile at moderate temperatures), have remained to the present time undetermined. It was with the view of adding something to our knowledge in this department that we recently undertook some experiments with potassium, the results of which we now beg leave to lay before the Society. The special difficulties we had to overcome are involved in the endeavour to answer the following questions:—

1. Is it possible to convert potassium into a gas of one atmosphere's pressure at any of the *constant* temperatures we can at present command?
2. Is it possible to generate *pure* potassium-vapour, and to keep it from getting oxidised?
3. Supposing a definite volume of such vapour to have been procured, how can its *weight* be ascertained?

After a succession of failures, which we shall not detail, we at last succeeded in devising a workable process, which may be briefly described as follows:—

A cylindrical iron bottle, of at least 200 c.c. capacity, of a thickness in the body ensuring sufficient rigidity at even a bright red-heat, and provided with a well-ground inbent neck, pierced with a canal of about 2 m.m. in diameter, is employed as a generator and receptacle of the vapour.

A mass of about 20 kilos. of zinc, contained in a plumbago crucible, which, being placed in a forge-fire, can be readily heated up to the boiling-point, serves as a bath.

The experiment begins hy first deoxidising the inside of the receptacle, at a red-heat, by means of a current of dry hydrogen, which is continuously maintained until the bottle has cooled down below redness. At this stage about 200 grms. of pure mercury are introduced into the bottle, which is then inserted into the red-hot zinc, without, however, covering the upper extremity of the bottle. After three-fourths of the mercury is distilled off (which is accomplished in a very short time), the neck is withdrawn, and while the mercury vapours are still streaming out, an iron test-tube, previously prepared with great care and charged with 4 to 5 grms. of potassium, is dropped into the bottle, the neck re-inserted, and, after the *whole* of the bottle has been immersed into the zinc, the blast of the forge forcibly increased, so as, in the shortest possible time, to bring the zinc into the state of boiling, proper arrangements being made for keeping the neck of the bottle red-hot. The potassium in a short time begins to volatilise, issuing in jets into the air, and depositing caustic potash at the nozzle, which must be kept clear by means of an iron wire. As soon as the distillation of the potassium ceases, the nozzle is closed by means of a ground-in wire plug, at once immersed into a mass of mercury, contained in a test-tube, and the bottle withdrawn to a proper support, on which it is allowed to cool.

After it has reached a manageable temperature, the bottle is inserted into a mass of recently boiled water, the wire plug withdrawn, and the hydrogen formed by the action of the water on the potassium pumped out by means of a "Sprengel" into a eudiometer, to be measured.

In the experiments we have hitherto carried out, we have satisfied ourselves that the amount of mercury vapour *not* swept out by the potassium is quite inappreciable; and as our object has been in the meantime to merely arrive at approximate results, and to perfect our methods of manipulation, we have neglected the minute correction which—on account of that small remnant of mercury—ought, strictly speaking, to have been applied to the volume of the vapour as calculated from the capacity of the bottle in the cold, the coefficient of expansion of iron, and the temperature (1040° Deville) at which the vapour was measured.

The results of our observations conclusively show that the density of potassium vapour, as produced in the process described, cannot exceed 45 times that of hydrogen, and that therefore the molecule of potassium consists of *two atoms* (K_2).

We intend to prosecute our research in other directions, proposing to ascertain, if possible, the densities of the *iodides* of cæsium, rubidium, and potassium, these being, according to Bunsen's experiments, the most volatile of the haloids of the alkali-metals.

* A Paper read before the Royal Society.

SEPARATING GOLD FROM ARGENTIC CHLORIDE.*

By ADOLPH LEIBIUS, Esq., Ph.D.,

Senior Assayer of the Sydney Branch of the Royal Mint.

In refining argentiferous gold by means of chlorine gas (Miller's patent), the silver is eliminated in the form of chloride of silver, or, as now termed, argentic chloride.

In the paper read by Mr. Miller before this Society, on December 1st, 1869, he described this process so fully that I need not refer to more of it than that part which speaks of the argentic chloride produced. This argentic chloride is never pure, but contains, besides chloride of copper, a considerable quantity of gold, stated by Miller, in the paper quoted above, as 2 per cent of the gold previously refined. If this auriferous argentic chloride is reduced to metallic state without freeing it of its gold, silver bullion results, containing from 12 to 20 per cent of gold, the average being about 18 per cent. This gold exists chiefly in combination with chlorine, and also as a double compound of chloride of gold and silver. By melting the chlorides in a boraxed clay pot, with from 8 to 10 per cent of metallic silver, the greatest part of this gold was removed, but never the whole. Miller states that, with proper care, the amount of gold remaining in the silver need not exceed 3 parts in 10,000. While such was the case in many instances during the time the experiments were going on, the amount of gold left in the silver bullion produced varied from 3 to 27 parts in 10,000, the average being 13 parts in 10,000. Lengthy experience obtained since has shown that, when working on a large scale, and therefore with less time at disposal than when engaged in experimental trials only, the results became still more variable, the gold in the silver bullion having been not seldom as much as 100 to 150 parts in 10,000, and often 10 to 40 parts in 10,000. This irregularity in the results obtained made it desirable to institute further experiments with a view of arriving at a method which

* Read before the Royal Society of New South Wales, November 20th, 1872.

would, if possible, take out all the gold, or at all events would only leave a minute and regular proportion of this metal in the silver bullion produced. To free the silver bullion from gold by dissolving it in acid would, in the Colony, where acids are very expensive, not be found remunerative, especially as silver bullion containing 5 grs. of gold per lb. troy can be more advantageously sold in London. When the auriferous argentic chloride is merely fused in a boraxed clay pot without any addition of silver or anything else, about 60 per cent of the gold therein is separated, while about 40 per cent remains in combination with the argentic chloride.

In the use of metallic silver, which was employed in strips about ⅛" thick, the silver thus added acts decomposing upon the gold compounds, forming chloride of silver, at the expense of the chlorine formerly in combination with the gold. The silver had to be in contact with every part of the molten chloride, which was, as much as possible, achieved by stirring the same with the silver strips employed. Was the heat of the furnace a little too great, and thus allowed the silver strips to melt too rapidly, the silver sank to the bottom of the pot with only a portion of the gold, producing a silvery gold button, while more or less gold was left in the liquid chloride. This, no doubt, was the chief cause of irregularity in the results obtained by employing silver strips. But, even had this not been so frequently the case, a considerable objection to its use would always have been the fact that a large amount of metallic silver would annually have been converted into argentic chloride, and back again into metallic silver.

To avoid this addition of metallic silver, and to substitute other reducing agents, a series of experiments was instituted; fusion, with addition of argol and of resin, as well as reduction by means of hydrogen gas, and also coal-gas, were successively tried; the results have, however, not been found sufficiently practicable.

The addition of carbonate of soda promised more success. Indeed, during the experiments carried on in the Sydney Mint in 1868-9, conjointly with Mr. Miller, by Mr. Hunt and myself, to test the applicability of the refining process on a large scale, the employment of soda for freeing the argentic chloride from gold was suggested by me; but only one trial was made, and, not having been carried out with the precaution which I now found to be required, a considerable loss in the operation caused its rejection in favour of the before-mentioned metallic silver strips. When soda is added in powder to fused chloride of silver, the action ensuing is very violent, and this causes a spitting and throwing up of metallic silver, thereby causing great loss; but when the fused chloride is covered with a layer of borax one-eighth to one-quarter inch in thickness, and the soda is gradually introduced on the top of this layer of borax, the action is found to be very gentle, and can easily be regulated. The quantity of soda required may vary from 16 to 20 ounces per 230 ounces of chloride, fused in a No. 18 boraxed French clay pot. Twenty ounces of soda produce a gold button weighing about 35 ounces, assaying from 870 to 880, while the silver bullion produced will contain from 2 to 5 parts of gold in 10,000 parts.

The operation is very regular in its results, but, as seen, not all the gold is removed thereby; in fact, in no case, even with an increased quantity of soda, was the whole of the gold removed in *one* operation. To produce silver bullion *free* from gold was, however, *always* successful when the argentic chloride was subjected to a second treatment, with about 3 ounces of soda pro 200 ounces of argentic chloride. This second operation is done similar to the first, but in a new pot, also boraxed; it requires a short time—about one hour. The argentic chloride containing only traces of gold from the previous treatment with soda, fuses much more readily than when it contains much gold. The time occupied by the first operation varies somewhat, according to the heat of the melting furnace and the character of the chloride. To fuse 230 ounces argentic chloride, after having been introduced into a red-hot pot placed inside a guard, takes from 60 to 80 minutes; the addition of the soda, from 20 to 30 minutes; after which the pot is covered, and the heat of the furnace increased to get all in good fusion, which takes from 10 to 20 minutes. The pot is then removed from the fire, allowed to cool sufficiently for the gold to solidify, when the still liquid argentic chloride is poured off into iron pans, and placed into the galvanic battery, a description of which I gave in a paper read before the Royal Society of New South Wales in December, 1869.

While the soda is being added, the top layer is occasionally gently dipped with a stirrer slightly underneath the molten chloride, without stirring the same; in fact, it is preferable not to stir the fused chloride, but to let the gold collect at the bottom of the pot, and to pour the chloride carefully off.

The presence of a large proportion of copper in the chloride has been found to prolong the operation considerably; it is therefore advisable to refine gold bullion containing much copper by itself, and to free the resulting argentic chloride, which therefore contains much copper, by dissolving the same after being reduced to the metallic state.

It is remarkable how uniformly the gold is diffused in the argentic chloride. Any portion of a slab of this chloride, free from borax, may be assayed for gold, and will be found alike. This offers a convenient means for ascertaining the result of the treatment with soda before the argentic chloride is placed in the battery for reduction. A small piece is broken off from one corner of the slab of chloride, and reduced to fine powder in a Wedgwood mortar; the powder is kept in a corked glass tube, and from thence weighed out for assay in an assay balance. Ten grains are wrapped in a piece of lead-foil 1½ inches square, and cupelled at low heat with about 60 grains of lead; the resulting silver button is boiled out, and the gold weighed.

This mode of assaying the chloride is so quick—six samples can be easily assayed, inclusive of powdering, in one hour—that it is well worth employing in all cases. Should the assay show more gold in the chloride than desirable, it must be subjected to another treatment with soda. Such a case need, however, only rarely, if ever, occur.

The question whether the *whole* of the gold should be removed from the chloride by a second treatment with soda, as described, or whether such additional expense for pot, fuel, &c., is better avoided, if silver bullion containing little gold were readily saleable, must naturally be left to the consideration of the circumstances attending each case.

DR. MORFIT'S TREATISE ON "MINERAL PHOSPHATES AND PURE FERTILISERS."

By A. ESILMAN.

I was induced since my last communication to carry out Dr. Morfit's process for the analysis of mineral phosphates on a mixture of known composition, made to represent a native impure phosphate, and in describing the details I will use his own words as much as possible. With regard to the remarks he makes in reply to mine on this point, I have simply to say that in his work he unreservedly puts forth his method as capable of distinguishing "what proportion of the phosphoric acid may belong to alumina, iron, and other bases than lime" (p. 432), and if it is at fault in this particular, on account of the backwardness of science, I think it would be better for him to do like other chemists—report phosphoric acid equal to phosphate of lime, in the full understanding that it is a method of expediency. Had this admission been made in his work it would have saved me from the trouble of making it manifest experimentally.

I made a mixture of 10 grs. phosphate of iron, 10 grs.

phosphate of alumina, 5 grs. ammonio-phosphate of magnesia, and 75 grs. bone-ash, freshly calcined. The ferric and aluminic phosphates were prepared from a solution of iron and aluminium alum respectively, mixed with excess of phosphate of soda, the precipitate re-dissolved in hydrochloric acid, and thrown down again by acetate of ammonium. This ensured the formation of phosphates of definite and normal composition, viz., Al_2O_3,PO_5 and $Fe_2O_3PO_5$. They were thoroughly washed, dried, and ignited. The ammonio-phosphate of magnesia was prepared in the ordinary way, and dried at 212°, having the composition $2MgO,NH_4O,PO_5+4HO$. The bone-ash was analysed, and gave the following results:—

	Per cent.
Tricalcic phosphate	86·48
Trimagnesic phosphate	3·62
Carbonate of sulphate of lime	9·50
Sand, &c.	0·50
	100·00

25 grs. were weighed out, dissolved in hydrochloric acid, and the insoluble separated by filtration. Dr. Morfit's prescription was now followed, and to separate the lime the requisite volume of alcohol was added, and then sulphuric acid in excess. In the book occurs the remarkable statement, "the filtrate is to be treated with pure sulphuric acid, added dropwise until it *reddens a piece of blue litmus paper dipped into it.*" The quantity of sulphate of lime thus obtained agreed very closely with the lime estimation by oxalate of ammonium.

The filtrate and washings were now gently evaporated to concentrate and expel alcohol, then treated with ammonia in tolerably large excess to precipitate phosphates and oxides of iron, alumina, and magnesia. After standing all night it was filtered off, and washed with ammoniacal water. Here my difficulties began. The filtration and washings were excessively tedious, occupying a whole day; and towards the close I found the washing waters becoming coloured owing to the re-solution of the ferric phosphate in the pure ammoniacal wash-water, described in chemical treatises. This necessitated a re-filtration, and washing with ammoniacal water containing chloride of ammonium, which was successful. The solutions on being boiled again deposited ferric phosphate, however, and a third tedious filtration and washing was gone through. The filtrate and washings were evaporated, treated with ammoniacal sulphate of magnesia, and the phosphoric acid determined. This I am told to calculate to phosphate of lime, to give the quantity existing in the raw mineral.

The precipitate by ammonia was dissolved in hydrochloric acid, and excess of caustic potash added to precipitate the phosphates of iron and magnesia, and re-dissolve the phosphate of alumina. The solution after separating the insoluble was acidified with hydrochloric acid, then treated with excess of carbonate of ammonia, which precipitated alumina and phosphate of alumina. In this precipitate, after being weighed, phosphoric acid was determined, calculated to $Al_2O_3PO_5$, and the alumina obtained by difference.

The insoluble in caustic potash was re-dissolved in hydrochloric acid, a slight excess of ammonia added, then excess of acetic acid poured in. The precipitate completely dissolved, showing the absence of phosphate of iron. The liquid was then diluted with hot water, exactly neutralised with ammonia, and the oxide of iron filtered off, washed, and weighed. The filtrate and washings, said to contain phosphate of magnesia, were then evaporated to a small volume, allowed to cool, and treated with excess of ammonia; but no precipitate was obtained after 36 hours standing. In every case the precipitates and waste washing liquors were examined, and any stray ingredient estimated.

I now subjoin the actual results and those obtained by Dr. Morfit's method:—

	Actual.	By Dr. Morfit.
Tribasic phosphate of lime	64·86	69·82
Tribasic phosphate of magnesia	2·72	none
Ammonio-phosphate of magnesia	5·00	none
Carbonate of lime	7·12	1·94
Phosphate of alumina	10·00	8·80
Alumina	none	1·60
Phosphate of iron	10·00	none
Oxide of iron	none	6·40
Sand, &c.	0·30	0·30
	100·00	88·86

According to the above will Dr. Morfit's method give results low in phosphate of lime? Not when the iron and alumina exist mainly as phosphate, though undoubtedly when they are free the calcic phosphate will come out too low. Again, what have become of the phosphate of iron, phosphate of magnesia, and part of the phosphoric acid? The phosphate of iron in presence of phosphate of magnesia has been almost completely decomposed by the caustic potash, the insoluble being ferric hydrate, magnesia, and a trace of phosphate of iron. This accounts for the complete solution of the precipitate in acetic acid, phosphate of iron being soluble in ferric acetate. The phosphoric acid belonging to the magnesia and oxide of iron going into the potassic solution with the aluminic phosphate remains in great part soluble when the latter was precipitated by carbonate of ammonia, and was not determined by Dr. Morfit. The magnesia, in like manner, was untouched when ammonia was added to precipitate and determine phosphate of magnesia.

I, however, estimated the quantities of these stray ingredients, and give them as follows:—

Phosphoric acid in the solution from alumina and phosphate of alumina	6·14
Phosphoric acid in the oxide of iron precipitate	1·02
Magnesia in the phosphate of magnesia solution	3·02
	10·18

This 10·18, with the ammonia and water in the 5 grs phosphate of magnesia, make up the analysis to 100·83 sum total.

Estimation of Fluoride of Calcium, p. 459.—After fusion with silicate of soda, separation of silica, he says, "The liquor is now to be treated with hydrochloric acid until it reddens blue litmus, and afterwards with a slight excess of chloride of calcium." Now, really, what is to be gained by this departure from the excellent method of Fresenius, by which any chance of incomplete precipitation of fluoride of calcium is prevented by using a slightly alkaline solution?

Similar errors pervade the methods given for the analysis of native phosphates of alumina and iron, and artificial manures. Take the analysis of Redonda phosphate, the presence of constitutional water is entirely ignored. After drying on a sand-bath, he calls the loss by ignition organic matter! Then, again, talking of the composition of native phosphates of alumina, he says (p. 506), "It may be wholly metaphosphate of alumina ($Al_2O_3,3PO_5$), or a mixture of that and pyrophosphate ($2Al_2O_3,3PO_5,10HO$) when dried at 110°, together with more or less of free alumina." Has Dr. Morfit, may I ask, proven the existence of meta- or pyrophosphoric acid in any sample of native phosphate, and if so, will he publish an account of his experiments?

If only the biphosphate of lime is to be determined in a manure, he tells you to add thin milk of lime to the aqueous solution as long as a precipitate forms; then after washing, dissolve the precipitate of phosphate of lime, alumina, and iron in hydrochloric acid, separate the lime as sulphate, and in the solution separate the alumina and iron by ammonia, and the phosphoric acid in the usual way. This gives, by calculation, the soluble phosphate.

The alumina and iron will mainly consist of phosphate, which was previously soluble, yet it will not appear in the percentage of soluble phosphate.

I think I have done enough to show the utter uselessness in many cases of his processes of analysis to effect the results intended. My only reason for criticising them so closely as I have done, is the high claim he lays for them as analytical methods. I quote from page 465 as an instance. After giving a recapitulation of the ingredients as obtained by the analysis of mineral phosphates, he adds, "The phosphoric acid is thus shown in its individual combinations, and not totalised as triphosphate of lime according to the meretricious style of '*commercial*' chemistry" (the italics and points are his).

Contrast this position with the language of his letter in the Chemical News, vol. xxvii., p. 114.

I have studied with much interest the two analyses of precipitated phosphate made from Navassa guano, and South Carolinian phosphate by process (B). It would have been more instructive if the iron and aluminium compounds had been classified. Their excessive proportion is greatly at variance with the statements in the book that process (B) "eliminates the iron and aluminium compounds usually present in the raw mineral phosphate, and thus delivers the phosphate of lime constituent as a pure product." (P. 238.)

It seems certainly very surprising for me to read in the letter referred to, that "it was almost impossible to adjust the ratio of pulp so as to prevent an excess of the latter" when 10 lbs. were operated upon, after statements in the book that the reaction was so delicate as to be capable of application to quantitative analysis, and that an excess of pulp could be removed "by the mere addition of some fresh liquor."

What I and others would like Dr. Morfit to show is, that ferric and aluminic phosphates and oxides, bodies so unstable (especially the phosphate) in solutions void of free acid (as the mother-liquors will be) should replace a stable definite compound like monocalcic phosphate in a solution. When any person can prove experimentally that solutions of calcic phosphate are decomposed immediately by ferric and aluminic salts, and slowly by their hydrates, it wants very strong and conclusive evidence to prove an opposite reaction.

I hope Dr. Morfit will not think me unduly fault-finding if I express my dissatisfaction even with the statement of phosphates of lime and magnesia in the two analyses referred to. In the precipitate from Navassa phosphate, the quantities of lime and magnesia are not sufficient to form dibasic phosphate with the phosphoric acid, and in that from South Carolinian phosphate, the bases are in excess of that required to form tribasic phosphate. Am I to suppose in the former case that some monocalcic phosphate is present, and in the latter, that free lime exists in the precipitate? I can *barely* believe that dicalcic phosphate might precipitate from a solution containing acid salts of iron alumina, but that a calcic phosphate even richer in base, and therefore more alkaline, than the tribasic salt, would form under those circumstances is beyond my comprehension.

The insurmountable difficulty I apprehend in the use of the pulp is its slimy, bulky nature. On the large scale it would be impracticable to manipulate, and before it could be used for either Spence's or Townsend's processes it would have to be washed free from chloride of calcium, an immense task. Again, I would call his attention to the fact that the presence of large quantities of phosphate of iron would destroy its applicability for either of these processes.

As to his remarks on the replacement of the superphosphate of the present day by precipitated phosphate, I entirely believe in its future accomplishment. There is no doubt that the latter serves all the manurial purposes of the former, and it only requires time to make the farmer believe it. In these days of dear fuel and rising wages, no process involving much manipulation will successfully compete with the present excessively simple one.

In conclusion, I may add that I think I have successfully shown that his process for the estimation of the quantity of phosphoric acid in phosphatic materials, and for the determining of its state of combination, is utterly valueless; that the methods for the determination of ammonia and nitric acid are equally unsound; and in reply to the charge of carping criticism, I will only add that if my remarks are handled in the same spirit that has actuated me in putting them forth, I will not complain. I fully admit the extreme professional sensibilities of chemists in general, and myself in particular. With regard to a method for the determination of the state of combination of phosphoric acid in minerals, I throw out the following suggestions which might serve as the basis of a correct process. By gentle ignition, ferric and aluminic phosphates are not at all altered in their degree of solubilities, while the corresponding hydrates are completely changed in this respect. By determining the iron and alumina in the raw phosphate treated with boiling dilute hydrochloric acid (say 1 of acid to 6 of water), and in the same way after gentle ignition at a low red heat, the former would give the phosphates and hydrated oxides, while the latter would represent the phosphates alone. A third determination of the total iron and alumina would furnish results for the calculation of the anhydrous oxides, and complete the series. Such data would only be of scientific interest. To the manure maker the only information desirable is the quantity which will enter into solution, and whether it exists as phosphate or oxide matters nothing so far as it exerts an action in the mixture.

I hope the little discussion raised by Dr. Morfit's work will elicit the opinions of others more qualified to speak on the matter.

Miles Platting, Manchester.

THE MANUFACTURE OF SULPHURIC ACID.*

By J. McCULLOCH.

The production of sulphuric acid being one of the most important processes carried on in a chemical manufactory, it is of course most essential that the manager of this department thoroughly understands the process theoretically and, what is of far greater importance, practically. If this is the case, the natural consequence will be that the best possible production will be obtained with the least possible outlay both of labour and material.

As we are a society formed for the purpose of discussing manufacturing as well as analytical chemistry, I intend confining my remarks in this paper more to the practical than the theoretical details.

Many different opinions are held as to the practical working of chambers, as well as to the theoretical principles, and, as I expect there are a number here who hold a different opinion to myself on the manufacture of sulphuric acid, I hope that if this paper does not altogether meet your views, the after-discussion may be the means of eliciting some further information which will be beneficial to us all.

We will now take a glance through the process, commencing with the burning of the pyrites. This is a very important part, and requires much care and attention, as upon this chiefly depends the proper produce of SO_3. The question arises as to which is the best form of burner for burning pyrites, so as to leave the smallest possible percentage of sulphur in the pyrites-cinders. We find so many different forms and sizes of burners in use in the various chemical works, each claiming to have some special or fancied superiority, that it is difficult to decide on the form which should come into general use, yet that

* Read before the Tyne Social Chemical Society.

he size and shape of the burner has a great deal to do with its efficiency in burning the pyrites there cannot I think be the slightest doubt.

A pyrites-burner should have two chief qualifications—First, it should be large enough to take in the necessary charge of pyrites, so that they can be spread over the surface in a very thin layer; secondly, it should be small enough to enable the workman to get at all parts of it with as little trouble as possible, in order that the burning pyrites may be thoroughly opened out, thus allowing a free current of air to pass through, for the purpose of oxidising the burning sulphur as well as the metallic substances.

In some works we find the burners built in a single row—charging the pyrites on the one side, and drawing the cinders on the other. I cannot see one single advantage this burner has to recommend its adoption, as it is very expensive to build, requires more space, and is very unhandy to work.

I was told by a manufacturer, who has them in his works, that one great advantage they possess is that, by by putting the green ore in at one side and drawing the burnt ore on the other, there is no danger of the green ore getting mixed with the burnt ore and so being lost. By inaugurating a proper system of working this can be readily avoided.

There is also another style of burner, which is made very large, and is charged with from 8 cwts. to 10 cwts. of pyrites.

The advantage claimed for this burner is the great saving of labour connected with it: it requires to be charged once only in twenty-four hours. Its disadvantages, I think, outweigh the advantage it possesses. A pyrites, such as the first quality of Norwegian, may be burnt, but, if an ore is introduced into them that is at all liable to scar or slag, the large burner is very objectionable. The reason is the burning ore does not get pokered up often enough; it gets into lumps, and I have known a case in which the pyrites became a solid mass, necessitating the removal of the entire front of the burner before the working could be proceeded with.

I do not think there could be anything better than the twelve hours system if the burners are not too heavily charged; the ore is pokered thoroughly every twelve hours, keeping it open and free from scars, thus causing it to burn very freely.

The draught can also be regulated to burn the pyrites properly, and I have no doubt but, with the light charge and twelve hours, the ore will be found to be much better burnt than with the heavy charge and the twenty-four hours system.

A great source of annoyance to manufacturers in making acid from pyrites is the accumulation of smalls. A number of plans have been tried to extract the sulphur, some of them with a fair amount of success, others proving quite a failure.

The system in general use at present is a furnace, commonly called a blind- or close-furnace. It is heated by a coal fire placed at one end; the flame passing between two arches descends at the end farthest from the fire, passing under the bed of the furnace, thence to the chimney. The green dust is generally charged at the end farthest from the fire, being gradually moved up to the hottest end, where it is drawn, the reason of this being that the first equivalent of sulphur is readily driven off, while the second requires an intense heat to separate it from the iron. A great objection to this system is the quantity of coal used; in some cases as much as 1 ton of coal to 1 ton of dust being required to expel the sulphur. There is also the danger of the arch of the furnace getting cracked, the consequence being that the sulphurous acid, instead of passing into the chamber where it is wanted, passes into the chimney along with the heated air from the fire, thus giving a small production of sulphuric acid on the sulphur charged into the furnace.

While at Messrs. Allhusen's I introduced a system of burning the small which has proved entirely satisfactory.

Two cast-iron plates are introduced into the ordinary pyrites-burner, the heat from the burning pyrites igniting the dust and driving off the sulphur. In a number of years' working it has been found that on an average the burnt dust does not contain more than 1 per cent more sulphur than the burnt ore, which is very satisfactory.

The burner is fitted with air-tight doors, and has a superficial area of about 17·25 feet.

The metal plates on which the dust is burnt are each 1′8″ × 5′2″ and about 1″ thick, resting on the brickwork at both ends and along one side. Along the front of the plate runs a flange about 3″ high, for the purpose of preventing the dust getting in among the stones while being worked. The dust-door is made in two halves, in order that it may work easier on the hinges. When a plate requires to be renewed (which, on an average, is once in six months) the half of the door that is fast is taken off, the old plate removed, and the new one put in, the entire operation occupying only a few minutes. The dust is charged with a scoop from the front, and is raked over about four times every twelve hours. A hanger of malleable iron is introduced through the arch of the burner, passing under the front of the plate, thus keeping it from sinking (as it otherwise would do) when brought to a red heat.

These burners are charged with 3¼ cwts. of pyrites per twelve hours and ½ cwt. of dust. Each plate burns ½ cwt. of dust per twenty-four hours, being charged alternately. Total charge per twenty-four hours per burner, 7½ cwts. These burners give good results, and are very easily wrought and regulated.

An objection has been sometimes raised to the admission of air to chambers through the dust-burners, the air taking up the chamber space, thus causing a loss in production. I think if the blind-furnaces are closely examined, the true cause of loss will be found in the dust having been badly burnt, or an escape of sulphurous acid through the openings in the brickwork. There is a greater danger, so far as good productions are concerned, in having too little oxygen in the chambers than in having even a very large excess. I have found over a number of years' working, with and without the dust-plates, that the produce of sulphuric acid is not at all affected by the extra quantity of air admitted while charging and working the dust.

Amongst the ores most suitable for the manufacture of sulphuric acid are Mason's, Tharsis, Norwegian, and Belgian ores. The following is the composition of some of the ores which I have burnt:—

Composition.	First Norwegian.	Second Norwegian.	Mason's.	Belgian
Sulphur	46·15	38·17	49·80	45·60
Iron	44·20	32·80	42·88	38·52
Copper	1·20	1·10	2·26	*nil*
Zinc	2·10	2·32	0·10	6·00
Arsenic	*nil*	trace	0·28	trace
Lime carbonate ..	2·55	11·90	0·18	0·11
Lime sulphate	trace	*nil*	*nil*	*nil*
Magnesia carbonate ..	—	1·08	—	—
Insoluble	3·20	12·20	2·94	9·00
Moisture	0·40	0·25	0·95	0·36
Total	99·80	99·82	99·39	99·59

The cinders from the above ores contained, on an average, the following percentage amount of total sulphur:—

First Norwegian.	Second Norwegian.	Mason's.	Belgian.
3·5	7·5	3·5	2·5

It will be seen that the second quality of Norwegian contains a large quantity of carbonate of lime, which militates very much against the burning of the ore. The sulphur combines with the lime, forming sulphate of lime, which, of course, remains in the pyrites-cinders, instead of going to form sulphuric acid in the chambers.

The manufacturer would best study his interests by selecting those ores containing the least quantity of lime compounds,

Some of the ores also contain more silica than others. This I have found to be not at all injurious to the burning, provided the burners are kept at a proper heat. Most ores when burned at a high temperature "scar;" it has, however, been ascertained that the scar itself contains very little sulphur, but it is well to prevent this, as there is the danger of the scar enclosing pieces of raw ore, and also stopping the proper current of air through the burning pyrites.

Sulphur, as is well known, on being burned in air is converted into sulphurous acid, a larger quantity of air being required for pyrites as compared with free sulphur, owing to the metals contained in pyrites absorbing oxygen to form oxides. The sulphurous acid passes into a flue in connection with the burners, in which are placed cast-iron vessels containing nitrate of soda and sulphuric acid, the heat of the gas decomposing the nitre, forming bisulphate of soda and nitric acid gas. The two gases react on each other, forming sulphuric acid and binoxide of nitrogen, the latter absorbing two equivalents of oxygen from the air, forming hyponitric acid, which is again acted on by the sulphurous acid, and thus acts as a carrier of oxygen from the air to the sulphuric acid. An excess of nitrous compounds or available oxygen must be always present, so that the whole of the sulphurous acid may be oxidised. A sample of nitrate of soda taken from the nitre-pots contained as follows:—

$NaOSO_3$	82·25
$HOSO_3$	17·15
Iron and alumina	1·30
Moisture	0·24
Total	100·94

Various opinions exist as to the reaction going on in the chamber; in fact almost every chemist who has investigated the subject takes a different view. The most simple theory which many chemists hold is the following:—

First .. .. $3SO_2+NO_5=3SO_3+NO_2$

Second .. $NO_2+2O=NO_4$

Third.. .. $2SO_2+NO_4=2SO_3+NO_2$

The nitrous compounds are, as will be seen, ultimately reduced to NO_2, after which it plays the part of carrier between the O of the air and the SO_2.

The agents, therefore, that we require in a chamber for the successful manufacture of sulphuric acid are sulphurous acid, hyponitric acid, air or oxygen, and steam.

It will be seen that a very small quantity of nitrate of soda is required to convert the sulphurous acid into sulphuric acid; in fact, if no loss were sustained, the chamber being once filled with the nitrous compounds, no more would be required. This, however, is not the fact in practice, for when the chambers are working properly, and every precaution used to recover the excess of nitrous compounds required in the making of acid, a loss of from 3 per cent to 6 per cent of nitre is sustained. There are three sources of loss—First, the acid on the chamber-floor absorbing nitrous compounds; second, from that which escapes absorption in the absorbing-towers; and, third, from the nitric acid remaining in the sulphuric acid after it has been passed through the denitrating columns.

(To be continued).

ON THE

SULPHUR DEPOSITS OF KRISUVIK, ICELAND.

By CHARLES W. VINCENT, F.C.S.

(Concluded from p. 114).

It is somewhat to be regretted that no one amongst the numerous eminent men, men accustomed to experimental investigations and acute observers, who have since traversed this region, should have investigated the question of the origin of these hot springs and sulphur deposits from the point of view which was thus displayed by these careful and painstaking philosophers.

The phlogistic theory being generally accepted in their day, and the chemistry of the earths and metals being in a very undeveloped state, we cannot now accept to its full extent the explanation they put forth of these phenomena; but the facts they disclose appear to me to be of the highest value, and to afford a clue which, if carefully followed, may lead to discoveries of much importance in the domain of volcanic energy.

The conclusion they drew from their investigation is, that the hidden fires of Iceland dwell in the crust of the earth, and not in its interior; that the boiling springs and the mud cauldrons certainly do not derive their heat from the depths of our globe, but that the fire which nourishes them is to be found frequently at only a few feet below the surface in fermenting matters, which are deposited in certain strata.

By their theory the gases from the more central parts of the earth penetrate these beds by subterranean channels, and so set up the chemical action, producing fermentation and heat, these channels also forming the means of intercommunication between the separate sites of activity, and equalising and transferring pressure.

To return to their facts. They further observed that the heat is invariably found to be greatest in the blue and bluish-grey earth; that these earths almost always contain sulphuric acid; that they contain also sulphur, iron, alum, and gypsum; and lastly, that finely-divided particles of brass-coloured pyrites are visible throughout the whole of the beds when heat exists.

Sulphuric acid is found in the hot beds above and below that which is the hottest, but this latter manifests no acidity that is sensible to the taste.

Sulphuretted hydrogen is continually evolved from the clays containing the brass-coloured pyrites. Silver coins dropped into a hole made in these strata become rapidly reddened, and brass becomes quite black if held over it for a short time.

Lastly, not only does the heat increase and diminish in various successive layers of the earth in the neighbourhood of the active springs, but the locality of the heat, as might be expected from their previous observations, travels very considerably in different years.

The solfatara of Krisuvik, with the mountains about it, is shown in the accompanying sketch by M. Eugène Roberts. It appears from afar to occupy the place of an ancient crater, but, as we have already seen, it is not near the crater about the centre of the drawing, but at a considerable distance from the old volcanic centre, that the thermal springs and sulphurous exhalations have their present origin.

Wherever they may have been previously, the springs are now situated between two mountains; the one, Badstofer, on the right, originally composed of lava, the other, Vesturhals, on the left, of basaltic formation. Both by the action of the thermal springs are undergoing a process of disintegration and reconstruction.

The kind of hills which form the solfataras, properly so called, increase in extent day by day, by the addition to the disintegrated rock of sulphnr, and of sulphurous and sulphuric acids.

The yellow sulphur earth contains about four per cent of free sulphuric acid; sometimes a little free hydrochloric acid, and a variety of sulphates, as might be supposed. Treated with distilled water the filtered solution reddens litmus strongly; on addition of acetate of lead a flocculent precipitate is produced, which, when heated with carbon, disengages sulphurous acid.

The sulphur is found in many different conditions, but for the most part in the same finely-divided, whitish-yellow form in which it is precipitated from sulphuretted hydrogen solutions. Where it assumes other states, crystallised in tears on the surface of the rocks, or coagulated in veins, it is on account of its having undergone subsequent heating. Of its primary origin by the decomposition of sulphuretted hydrogen, there is in my opinion no doubt.

Prof. Bunsen visited Krisuvik in 1845: his opinion is that sulphurous acid is evolved from the earth's interior, which, oxidised either at the surface by the atmosphere, or at subterranean depths by atmospheric oxygen dissolved in cold water, is converted into sulphuric acid. The sulphuric acid thus generated is diffused among the constituents of the decomposed beds. This process represents the first stage of the fumerole action, which is manifested in the namar or solfatara of Krisuvik.

Sulphur is now generally regarded as emanating from the stage of intermittent lethargy of a volcano, and the sulphides of iron, copper, arsenic, zinc, selenium, &c., fall in the same category as sulphur; they are secondary, not primary, formations. In the stage further off we have the host of sulphates produced by the oxidation of the sulphur into sulphuric acid, and its subsequent reaction on the metals and earths with which it becomes associated.

The description of the Sicilian sulphur beds coincides so very exactly with that of the Icelandic mines, that one might pass very well for the other. D'Aubigny pictures nearly the whole of the central portion of Sicily as being occupied by a vast bed of blue clay or marl, in which are numerous and thick beds of gypsum and sulphur, and a combination of this mineral with iron and copper. The natural process by which they have been formed must, I think, be the same in each case. At Krisuvik copper has been found only in small quantities, but that is probably because it has not been sought for below the surface. Carbonate of copper, associated with sulphate of lime, is of frequent occurrence, and native copper has to a limited extent been discovered.

A district in America, very similar in most of its characteristics, has recently been explored, The great hot-spring region of the sources of the Yellowstone and Missouri rivers, in the United States, has, on account of the wonderful natural phenomena there manifested, been set apart by the United States Congress as a great national park for all time.

The whole of this district is covered with rocks of volcanic origin of comparatively modern date. At present there are no signs of direct volcanic action going on, but the secondary kind of action, resulting probably as at Krisuvik, from the disintegration and decomposition of beds of volcanic origin, is in full progress. Boiling springs, mud cauldrons, and geysers are found in all parts of the region, and the description given by Mr. V. Hayden, of the Yellowstone lake and its vicinity, in every respect coincides with those of the geysers, mud cauldrons, and hot springs of Iceland.

In all cases there was found to be free access of water; free sulphur was widely dispersed, and the steam-jets were invariably accompanied by large quantities of sulphuretted hydrogen. The subterranean action in this country does not appear to have continued long enough to produce beds of sulphur and sulphur earths; but has, nevertheless, been of sufficiently long standing to build up geyser tubes of so great a length that the internal pressure has formed other vents, rather than lift the immense column of water above it.

The water of the springs contains sulphuretted hydrogen, lime, soda, alumina, and a slight amount of magnesia; some of these are only occasionally at the boiling-point, and these, when the temperature is reduced below 150° F., deposit great quantities of the sesquioxide of iron, which lines the insides of the funnels, and covers the surface of the ground wherever the water flows. If the reaction consists in the decomposition of iron pyrites, and the sulphur is carried sufficiently far off to prevent its re-combination with the iron to form iron sulphate, the formation of the iron sesquioxide is fully accounted for.

As a rule, the groups of hot springs are, as in Iceland, in the lower valleys, and either along the margins of streams, or nearly on a level with them. The grand area where they occur is within the drainage of the Yellowstone, where a space of 40 miles in length with an average width of 15 miles, is either at the present time, or has been in the past, occupied by hot springs.

That the quantity of sulphuric acid here produced is very large is proved by the immense quantity of alum which is found, for the streams, the mud, the earth are thoroughly impregnated with it. The funnel-shaped craters from which the boiling mud is ejected, are so similar to those at Krisuvik that the figure on page 113 will answer for both places. The circular rim varies from a few inches to several feet in diameter. Sometimes these are clustered close together, yet each one being separate and distinct from the others.

The foregoing are the most prominent facts connected

with the development of sulphur from the earth in the elementary state. The full explanation of all the phenomena accompanying it appears to me to be the key by which the great secret of volcanic energy may be ultimately unlocked. At present it appears to be doubtful whether the sulphur results from the decomposition of metallic sulphides, by heat and water combined, or by sulphuric acid formed by the oxidation of sulphurous acid. In the one case, the whole action is so far within our reach that it should not be an insurmountable difficulty to establish the point as to whether the whole action does not depend on the percolation of water into beds of pyrites surrounded by other beds which are non-conductors of heat.

The other view, viz., that the sulphur proceeds as sulphurous acid from a lower depth, is, on account of the more complicated action required, far from being as satisfactory to my mind as the more simple supposition above.

Until boring experiments have been made, conducted with great care, and to considerable depths, no positive conclusion can be arrived at. It is also an element in the question of much importance to discover whether the beds penetrated by the water are already heated, whether the water is heated before it reaches the sulphur-bearing strata (the clays containing pyrites), or whether both are not alike cold till they have been for some time in contact.

Less than a quarter of a mile from the hot springs is a lake, Geslravatn, formed by the filling up of an extinct crater. This the inhabitants describe as being fathomless (Mr. Seymour, last year, found no bottom at five and twenty fathoms). The depth is, at any rate, very considerable. Although so close to a spot where the ground is, even at the surface, scorching to the feet, the water in this lake is ice-cold. Sir George Mackenzie also remarked a somewhat similar fact. On the side of the sulphur mountain, amidst the seething, steaming hills of almost burning earth, a spring of clear cold water was met with. To my mind these facts are most in accordance with the view that the action is local and self-dependent.

The Krisuvik sulphur mines have been worked at various times, but want of proper roads, and ignorance of the proper method of extracting and refining the sulphur, have prevented their proper development. The Sicilian mines can be worked at a considerable profit, where, more than 390 feet below the surface, beds are met with containing only 15 per cent of sulphur. At Krisuvik, absolutely on the surface, clays are met with which contain from 15 to 90 per cent of sulphur. Under proper and careful supervision their future should be prosperous.

Two German gentlemen, under the auspices of the Danish Government, worked these mines in the early part of the last century, and so much was exported to Copenhagen during the time the excavations were carried on, that a sufficiently large stock was laid up to serve the consumption of Denmark and Norway from 1729 to 1753.

Horrebow describes the sulphur mines as being actively worked from 1722 to 1728, to the great advantage of the inhabitants, who reaped much profit from its extraction.

By his account of their mode of prosecuting this enterprise, the sulphur does not appear to have been refined in the island, but exported in its crude state. The less active mines were chosen for cutting into. He says:—There is always a layer of barren earth upon the sulphur, which is of several colours, white, yellow, green, red, and blue. When this is removed the sulphur earth is discovered, and may be taken up with shovels. By digging 3 feet down the sulphur is found in proper order. They seldom dig deeper, because the place is generally too hot, and requires too much labour, also because sulphur may be had at an easier rate, and in greater plenty, in the proper places. Fourscore horses may be loaded in an hour's time, each horse carrying 250 lbs. weight. The best veins of sulphur are known by a kind of bank or rising in the ground, which is cracked in the middle. From hence a thick vapour issues, and a greater heat is felt than in any other part. These are the places they choose for digging, and after removing a layer or two of earth, they come to the sulphur, which they find best just under the rising of the ground, when it (the sulphur) looks just like sugar candy. The farther from the middle of the bank the more it crumbles, at last appearing as mere dust. But the middle of the bank is an entire hard lump, and is with difficulty broken through. The brimstone, when first taken out, is so hot that it can hardly be handled, but grows cooler by degrees.

In two or three years these veins are again filled with sulphur. The death of the person at Copenhagen who had the sole and exclusive privilege of exporting sulphur from Iceland put an end to what had promised to be a very thriving industry. The inhabitants continued to collect the sulphur-earth for some time after its exportation had ceased; and many of them lost considerably by it, large quantities having been gathered which they were never able to dispose of.

According to Dr. Perkins, the sulphur mines were again worked by the Danish Government for fifteen years, but the method of purifying adopted was very imperfect. The sulphur-earth was heated in iron boilers, and, when the sulphur was melted, fish oil was added, and the whole mass stirred up. On allowing the mixture to stand for a time, the earthy matter formed a soap on the top of the molten mass; this being removed, tolerably pure sulphur remained behind.

In 1832, these mines were visited by K. von Nidda, the celebrated geologist, by whose advice a Danish merchant, named Kruntynon, purchased them. He only worked them for a short period. The sulphur-earth was collected without much regard being paid to the relative richness of the beds. It was taken on the backs of horses to Havnafiord, and thence shipped to Copenhagen. The cost of transport brought the sulphur to too high a price to render the undertaking successful.

In 1857, political matters caused the attention of Her Majesty's Government to be directed to finding a new source of sulphur supply. Commander J. E. Commerell, of Her Majesty's ship *Snake*, was sent to Iceland by the Lords Commissioners of the Admiralty, to visit and report upon the capabilities of the mines of Krisuvik and Husavik. He found that the nearest safe port to the Krisuvik beds was Havnafiord; this port is 14 miles from the sulphur-beds by the present roads, and 9 miles from Reikjavik. The harbour is well sheltered, with good anchorage of 7 or 8 fathoms three cables length from the beach; it at present enjoys as much traffic as Reikjavik. The road from Krisuvik might be much shortened, and a tramway might also be laid down. During the past year a survey has been made, and plans drawn, for a railway or tramway to Havnafiord.

The actual extent of the sulphur-beds it is quite impossible to calculate; forty-seven have been already discovered. The deposit of sulphur Commander Commerell personally saw he describes as amounting to many thousands of tons, and, all the mines being in what is called a "living" state, the sulphur taken away is reproduced in two or three years. He considers that sulphur in a pure state could be shipped at Havnafiord for £1 per ton.

The sulphur at Myvatn, though great in quantity, is, he considers, at too great a distance from a port of embarkation to permit its extraction being carried on with any chance of competing with that from the Krisuvik mines.

No further steps were taken in the matter by the British Government, the political complications which led to the expedition having been removed; but the attention of English merchants having been drawn to these rich deposits by the highly favourable character of Commander Commerell's remarks, renewed attempts are being made to render commercially available the immense sulphur-producing power which the

Krisuvik solfataras undoubtedly possess. To some of these gentlemen I am greatly indebted for much valuable information, put at my disposal for the purposes of this paper, and, amongst them, I have specially to tender my thanks to Mr. Ramsdale and Messrs. Thorne, of Gracechurch Street, and particularly for the use of numerous and carefully-selected samples of the sulphur-earths which were freely placed at my disposal. These samples I hope to make the subject of a future paper.

Since writing the foregoing paper, I mentioned, in the course of conversation with Sir Henry Holland, the conclusions which are derived from the examination of all the trustworthy facts relating to the sulphur deposits. This led him to examine entries in his unpublished diary, made at Krisuvik in 1810. The theory which he then conceived so thoroughly agrees with all that has been learnt respecting the phenomena in question, that I, with his kind permission, print an extract from his note-book:—

"The theory of these sulphurous springs (if springs they may be termed) at Krisuvik is an interesting object of inquiry. They are situated in a country decidedly of volcanic origin. The high ground on which they appear is composed principally of the conglomate or volcanic tufa, which has before been noticed. The source of the heat which can generate permanently so enormous a quantity of steam must, doubtless, reside below this rock; whether it be the same which produces the volcanic phenomena may be doubted, at least if the Wernerian theory of volcanoes be admitted. It certainly seems most probable that the appearances depend upon the action of water on vast beds of pyrites. The heat produced by this action is sufficient to raise an additional quantity of water in the form of steam, which makes its way to the surface, and is there emitted through the different clefts in the rocks. The sulphates of lime and alumina, appearing upon the surface, are doubtless produced, in process of time, by these operations. In corroboration of this view it may be observed that the quantity of steam issuing from the springs at Krisuvik is always greater after a long continuance of wet weather, and that whenever earthquakes occur on this spot it is during the prevalence of weather of this kind."

The learned, and now aged, author expressed the highest gratification that the views which he formed at twenty-two years of age should possess so much value so many years after.

During the reading of the paper Mr. Vincent illustrated his subject by several experiments, showing how the deposition of sulphur might have been effected. He also showed a spectrum obtained by burning some of the sulphur-earth, and it appeared that the thallium line became visible in the spectrum. Specimens of the various sulphur-yielding earths from Iceland were exhibited, and Dr. Clement Le Neve Foster showed samples from the Italian sulphur districts.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 6th, 1873.

Dr. Gladstone, F.R.S., Vice-President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, and the donations to the Society announced, the names of Messrs. E. H. Fison, Charles Thomas Kingzett, Alonzo J. Rider, William Andrew Prout, B.A., Roland Finch, William Morgan, Ph.D., and Henry Richardson, were read for the first time. For the third time—Messrs. George Ainsworth, Alexander Bottle, Richard Joseph Deeley, and James Walter Montgomery, who were then ballotted for and duly elected.

The first paper, "*On the Action of Hydrochloric Acid on Codeine*," was then read by the author, Dr. C. R. A. Wright, who, after referring to a former paper, containing an account of the action of hydrochloric acid on morphine, stated that codeine, treated with hydrochloric acid at 100° for $2\frac{1}{2}$ hours, gave a mixture of two bases, $\overline{C}+3HCl$ and $\overline{C}+4HCl-2H_2O$, where $\overline{C}$ stands for $C_{36}H_{42}N_2O_6$. When the action was continued for a longer time, methyl chloride was evolved, and a mixture of two isomeric bases obtained, intermediate in composition between morphine and "apomorphine"—namely, $\overline{M}_2-2H_2O$ and $\overline{M}_4-4H_2O$ respectively, where $\overline{M}$ equals $C_{34}H_{36}N_2O_5$. With hydrobromic acid the first action was similar to that of hydrochloric acid, but its continued action gave rise to products which are not identical with those formed by means of hydrochloric acid, whether at 100° or at a higher temperature. An extensive table of the derivatives of codeine obtained up to this time accompanied the memoir.

After the Chairman had expressed the thanks of the Society to Dr. Wright for his valuable and laborious researches on this subject, a paper "*On New Processes for Mercury Estimation, and some Observations on Mercury Salts*," by J. B. Hannay, was read by the Secretary. The author, finding the ordinary processes for the determination of mercury either very tedious or deficient in accuracy, has devised two new ones which are free from these objections. The first, which is a volumetric method, depends upon the fact that potassium cyanide dissolves the precipitate produced by ammonia in a solution of mercury chloride. A few drops of ammonia are first added to the solution containing the mercury in the state of chloride, and then a standard solution of potassium cyanide until the turbidity produced by the ammonia disappears. If arsenic, copper, &c., be present, the solution should be precipitated by sulphuretted hydrogen, the arsenic, &c., separated by sulphide of ammonium, and the mercury sulphide dissolved in aqua regia. The other method consists in decomposing the mercury, in solution as sulphate, by the electric current in a platinum basin, the mercury being deposited on the basin in the metallic state and weighed as such. The author has also made several experiments on mercury salts, and finds that hydrochloric acid completely decomposes mercury sulphate, and that mercury chloride can even be boiled with concentrated sulphuric acid without suffering decomposition.

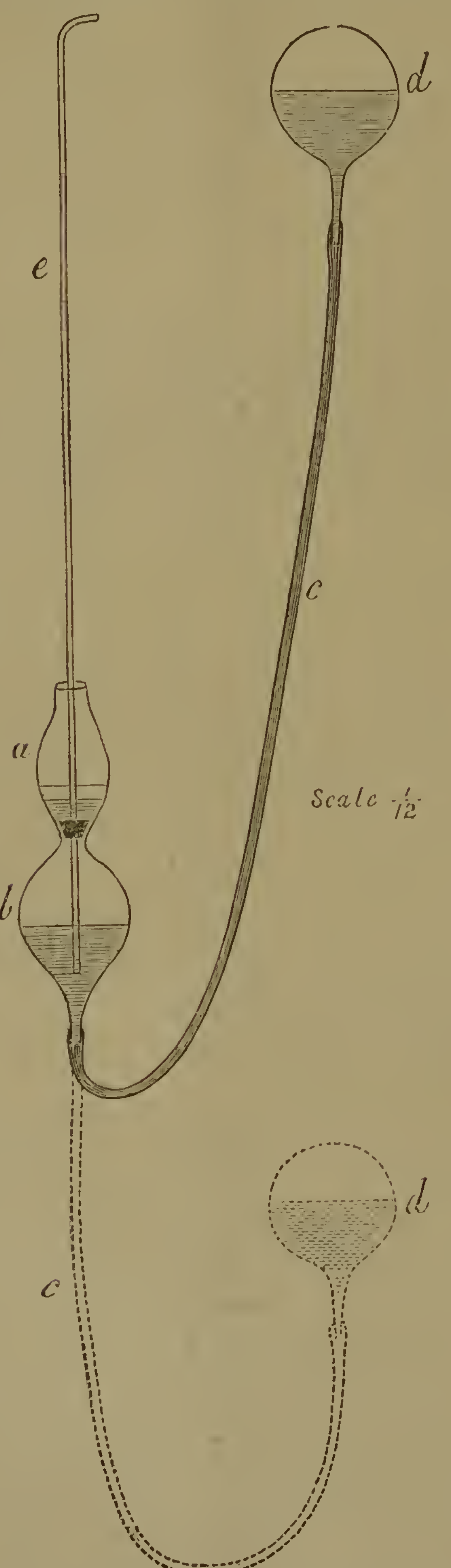
Mr. F. Field remarked that, in separating the arsenic and antimony, potassium sulphide must not be used, as mercury sulphide was comparatively soluble in it.

The next paper, "*On a Method of Estimating Nitric Acid*," by T. E. Thorpe, F.R.S.E., was also read by the Secretary. The author finds that the copper-zinc "couple" of Messrs. Gladstone and Tribe completely decomposes nitrates with formation of ammonia, which can then be estimated as platinochloride, or, if the amount be but small, by Nessler's test; particular care, however, is required with ammonium nitrate, the strength of the solutions employed considerably affecting the result. The author believes that this process, applied to the determination of nitrates in potable waters, possesses considerable advantages over the ordinary method—namely, by avoiding the introduction of nitrates in the potash or soda employed, and the frothing of the strongly alkaline solution when distilled. The author also employs the "couple" for the reduction of chlorates and iodates: it seems to have no action on urea.

Dr. Gladstone said he had listened to the paper with great interest, and would welcome every labourer in the extensive field opened up by the use of the copper-zinc couple, since it was of great importance that we should know what substances were decomposed by it and what were not.

Mr. W. Thorp said he was much pleased with the paper, and had no doubt the method would be valuable in determining nitrates when they were present in tolerably

large quantity, but he did not see the advantage it presented for water analysis over that devised by the late Mr. Chapman. He had made several hundred determinations by the last-mentioned process, but had never met with the difficulties mentioned by Dr. Thorpe. The presence of any trace of nitric acid in the potassic hydrate was readily removed by boiling the solution with a little aluminium. From the account given of it in the paper, he should imagine the new method to be more troublesome and tedious than the old one.



Dr. Debus quite agreed with the speaker that the new method did not seem to possess any practical advantages over the old one. It was, however, interesting from a theoretical point of view that zinc and copper in contact should reduce nitric acid to ammonia.

A "*Note on a Reaction of the Acetates upon Lead Salts, with Remarks on the Solubility of Lead Chloride*," was then read by the author, Mr. F. Field, F.R.S. When sodium chloride is added to either lead acetate or nitrate, a white precipitate is formed, which is generally regarded as lead chloride; it is, however, entirely dissolved by acetic acid for the moment, crystals of lead chloride separating from the clear solution only after the lapse of a short time. By far the most sensitive test for the presence of acetates or formates is a copper salt in the presence of sodium chloride, for when such a solution is heated, a copious precipitate of oxychloride of copper is immediately produced. The author has also made some determinations of the solubility of lead chloride in a solution of sodium chloride, and notices the ease with which lead sulphate is decomposed by hydrochloric acid or sodium chloride, so that sulphuric acid produces no precipitate in a solution of lead chloride in sodium chloride.

In reply to a question by Dr. Voelcker, the author said he had not made any attempt to ascertain whether this method could be employed for the quantitative determination of acetic acid.

Dr. Russell then took the chair, which was vacated by Dr. Gladstone to read a communication entitled "*Observations on the Nature of the Black Deposit in the Copper Zinc Couple*, by J. H. Gladstone, F.R.S., and A. Tribe, F.C.S. As it had been suggested that the black deposit referred to, contained more or less metallic zinc, the authors had instituted experiments to ascertain the truth of the matter. When the solution of copper sulphate is poured on the zinc, a deposit of pure copper is produced as long as the solution contains any of that metal. As soon, however, as the copper is exhausted, other reactions supervene: zinc oxide is formed by the action of the oxygen dissolved in the water, and metallic zinc is also deposited. Such a black deposit examined under the microscope is seen to consist of branches of crystallised copper studded with crystals of metallic zinc, the latter of which at once disappear if washed with a solution of copper sulphate. It would therefore appear that the black deposit on the copper-zinc couple as usually prepared can contain little or no metallic zinc. The authors also made some remarks on the platinum-zinc and gold-zinc couples, which, as might have been expected, are more active than the copper-zinc couple, and concluded by a discussion of the theory of the electro-chemical actions involved.

Dr. Russell, after returning the thanks of the Society to the authors for an account of their exceedingly interesting experiments, said that the statement, that as long as there was excess of copper sulphate in solution no zinc was deposited along with the copper on the zinc plate, was at variance with certain experiments he had made some time ago. When a zinc plate is immersed in a dilute solution of copper sulphate, it immediately becomes covered with a black deposit; but if the plate be moved about in the liquid so as to remove it from the solution of zinc sulphate formed in contact with it, the deposit immediately acquires a red colour. The black deposit, moreover, evolves hydrogen when treated with acid, whilst the red does not.

Dr. Muller remarked that iron plunged into a solution of sulphate of copper gives at once a red deposit; moreover, any metal appearing black from being in a minutely divided state acquires its proper colour on being rubbed with an agate burnisher, but this black deposit does not.

Dr. Wright observed that, *a priori*, it was quite possible that zinc and copper should be deposited together, since brass could be electro deposited.

Dr. Schenck drew attention to the fact that when a couple of copper and cadmium is immersed in a solution of cadmium sulphate, metallic cadmium is deposited on the copper.

A note on "*An Air-Bath of Constant Temperature Between* 100° *and* 200° C.," by Dr. H. Sprengel, was then read. This ingenious contrivance consists of a bath, similar to the ordinary hot-water oven, made of sheet-lead autogenously soldered, and filled with dilute sulphuric acid boiling at the desired temperature. In order that the temperature may remain constant, the water which distils from the

dilute sulphuric acid is condensed and allowed to flow back again into the bath by means of a worm of lead cooled by the atmosphere, or a long vertical metal or glass tube.

Dr. Russell in thanking the author, said the Society was much indebted to him for his simple and ingenious form of air-bath, and finally adjourned the meeting until Thursday, March 20, when a lecture "On Iron and Steel" will be delivered by C. W. Siemens, Esq., F.R.S., &c.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 18th, 1873.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

Dr. Joule, F.R.S., gave some further account of the improvements he had made in his air-exhausting apparatus. As stated in the last *Proceedings*, he had substituted a caoutchouc tube, attached to the neck of a glass vessel, for the original perpendicular pipe with its stopcock. This is seen in the sketch (see preceding page), *c* and *d*. The two positions—viz., when *b* is being filled, and when it is being emptied—are shown by the full and the dotted drawing. It is convenient to introduce no air into *d* except that required to act as a cushion to avoid a shock when filled in the lower position. Sulphuric acid may be introduced into the receiver to be exhausted, but it is perhaps more convenient to place it over the mercury in *a*, whence it may occasionally be drawn into *b*, to effect the drying of the internal parts of the apparatus. Dr. Joule has met with some difficulty in using mercury gauges to ascertain the residual pressure, inasmuch as he finds that mercury thoroughly boiled in clean glass tubes does not show a convex surface, but adheres strongly to the glass. However, he has confidence in giving the following results, in working with his apparatus with acid of various strength, obtained by successive dilutions of sulphuric acid of sp. gr. 1·845 by volume:—

Sulphuric Acid.		Water.		Pressure in Inches of Mercury.
3	+	0	..	Inappreciable
3	+	1	..	Inappreciable
3	+	2	..	0·01 at 70°
1	+	1	..	0·03 at 63°
1	+	2	..	0·15 at 63°
1	+	4	..	0·30 at 55°
0	+	1	..	0·37 at 47°

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts o all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Le Moniteur Scientifique Quesneville, March, 1873.

Contains the following original memoirs relating to chemistry and collateral subjects:—

Mode of the Formation of the Tissues in the Animal and Vegetable Organisms.—Ch. Blondeau.—A physiologico-chemical essay.

Present Condition of Agricultural Science in France and Other Countries.—L. Mussa.—The continuation of this monograph. This portion is divided into the following sections:—Aërial nutrition; carbonic acid; nitrogen; respiration of plants; elaboration of the juice in the leaves: perspiration of plants; flowers (blossom, bloom), their functions; the fruit; seed, grain and its ripening; the seeds of plants; germination of the seed. To be continued.

On Aniline Blacks.—C. F. Brandt.—This paper treats at length on the modes of preparation, formation, and nature of the aniline blacks, which consist, according to the author, of two distinct blacks mixed together in variable proportions. One of these, formed by the chlorated substitutes of aniline, is very fast, resisting almost all chemical reagents; but alone it is less beautiful than the other black, the product of the oxidation of the aniline salt. This substance really exhibits a deep violet-blue hue, which appears black in the concentrated state, but it is far less fast than the former; and although it resists soap, it becomes of a greenish colour by even very weak acid. In order to obtain a beautiful as well as a fast black, it is necessary for the two blacks to be present in proper proportion, and this depends upon the proportion of chlorate contained in the mixture.

New Researches on Propionic, Butyric, and Valerianic Acid.—T. Pierre and E. Puchot.—This exhaustive monograph is divided into the following sections:—Propionic acid, its mode of preparation; salts, viz., baryta, silver; butyric acid, its mode of preparation from butylic alcohol by oxidation, and properties of the acid; salts, viz., baryta, silver, ethylic, methylic; valerianic acid, mode of preparation from valerianate of potassa.

Bibliography.—Under this heading attention is called to the following new publications:—"Traité de la Détermination des Terres Arables dans le Laboratoire," par M. P. de Gasparin; Paris: G. Masson. This book has been specially written for agriculturists, and contains instructions for the easy estimation of phosphoric acid, potassa, lime, magnesia, soda, silica, iron, alumina, &c. in arable soils. All the described processes of analysis have been tested and practically studied by the author, who is an eminent practical agriculturist, and also a distinguished chemist. "L'Année Scientifique et Industrielle, ou Exposé Annuel des Travaux Scientifiques, des Inventions et des Principales Applications de la Science à l'Industrie et aux Arts qui out Attiré l'Attention Publique en France et à l'Etranger, Accompagné d'une Nécrologie Scientifique," par M. Louis Figuier; Paris: Hachette et Cie. The sixteenth yearly volume of this work contains a *resumé* of the labours of scientific institutions and societies. The other portions of this valuable *recueil* have also been greatly extended.

Les Mondes, March 6, 1873.

Election of Berthelot.—This celebrated *savant* has been elected one of the Fellows of the Académie des Sciences by a large majority.

Synthesis of Acetic Acid.—A. and J. Thenard.—By passing the electric current of a Ruhmkorff coil through a mixture of carbonic acid and protocarburetted hydrogen, the authors have, in the presence of M. J. Dumas, obtained acetic acid: thus combining two inorganic compounds in an organic substance.

Artificial Production of Cold by the Expansion of Air.—J. Armengaud.—The author has constructed an apparatus in which the air may be made to expand so rapidly, that while on entering its temperature is 15° it leaves the apparatus at −20°.

Volatilisation of Iron.—Dr. Elsner.—The author, director of a royal porcelain manufactory at Berlin, has placed in an unglazed porcelain crucible, closed with a lid, a piece of malleable iron, and exposed it for several hours to a temperature of at least 3000° (the heat of the porcelain kiln). On withdrawing the crucible from the kiln the lid was found lined with small crystals (needle-shaped) of iron which had been volatilised.

Bibliography.—"L'Architecture du Monde des Atomes," par M. A. Gaudin; Paris: Gauthier-Villars. This work is highly spoken of by the celebrated *savant*, Dumas, and contains the results of the author's labours during the last forty years. "Les Machines; leur Historie, leur Description, et leur Usages," par E. With; Paris: Baudry. A complete mechanical technology, illustrated by woodcuts, and full of useful as well as practical information.

Petites Annales de Chimie.—E. J. Maumené.—The twelfth portion of this monograph, elucidated by a large number of algebraico-chemical formulæ.

Flame of Compressed Gases.—F. Benevides.

Annalen der Chemie und Pharmacie, vol, clxvi., No. 2, March 1, 1873.

On Some New Derivatives of Sulpho-Carbaminic Acid.—H. Hlasiwetz and J. Kachler.—In the introduction to this essay the authors refer to the researches of Städeler and E. Mulder on this subject. Then we have the detailed account of the mode of preparation and properties of a peculiar combination of ammonia and sulphide of carbon, which is formed only when the two bodies are reacting upon each other in the presence of camphor. The new substance so obtained is a solid crystalline material, formula, $C_2H_{10}N_4S_2$. It is unstable, and readily decomposed by nitric acid and caustic alkalies; it yields with sulphate of copper a yellow-coloured compound—

$$C_2H_2Cu''N_2S_2.$$

When the body first mentioned is treated with perchloride of iron, there is formed a new compound, $C_2H_4N_2S_3$, a crystalline substance, quite insoluble in water and ether, but soluble in boiling alcohol. The body $C_2H_{10}N_4S_2$ forms with aniline a crystalline compound, soluble in boiling alcohol, formula, $C_{14}H_{18}N_4S_3$. The authors propose to call these compounds "thiuram" (from θειων) because the group NH_2-CS- prevails in these bodies. A series of formulæ, with the addition of the old and new names, is given.

Some of the Nitrogen Compounds of Anthrachinon.—R. Bœttger and Th. Petersen.—The second instalment of a monograph on this subject. This portion is divided into the following sections:—α-mononitro-anthrachinon, $C_{14}H_7(NO_2)O_2$; α-monoamido-anthrachinon, $C_{14}H_7(NH_2)O_2$; α-diazo-anthrachinon-nitrate,—

$$C_{14}H_7N_2O_2.NO_3;$$

behaviour of mononitro-anthrachinon with concentated sulphuric acid.

The Vanadates of Thallium.—Th. Carnelly.—This essay, elucidated by a large number of formulæ, treats exhaustively on the combinations of vanadic acid with thallium.

On Ethylamyl.—H. Grimshaw.—An abstract of the author's published memoir on this subject, an observation also applying to the memoir previously mentioned.

Heptanes of the Petroleum.—C. Schorlemmer.—This monograph, elucidated by a large number of formulæ, treats more particularly on an acid, $C_7H_{14}O_2$, very similar to isoenanthylic acid, boiling-point 209° to 213°, and on the ketone and other derivatives.

Crystallographical Communications.—C. Klein.—Illustrated with engravings.

Observations on My Water Air-Pump (Pompe Syrène).—N. Jagn.—The contents of this paper bear upon the rectification of some misunderstanding in reference to the construction, mode of action, and principles involved in this instrument.

On Excretin.—Dr. F. Hinterberger.—This paper treats on a peculiar substance which occurs in small quantity in human excrements, and was first noticed by Marcet. The author gives a detailed account of the mode of preparation of this substance, which has the formula, $C_{20}H_{36}O$, and combines with bromine, forming the compound—

$$C_{20}H_{34}Br_2O.$$

MEETINGS FOR THE WEEK.

Monday, March 17th.—Medical, 8.
Tuesday, 18th.—Civil Engineers, 8.
—— Zoological, 8½.
—— Anthropological, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
Wednesday, 19th.—Society of Arts, 8.
—— Meteorological, 7.
Thursday, 20th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
—— Zoological, 4.
—— Chemical, 8. C. W. Siemens, F.R.S., "On Iron and Steel."
Friday, 21st.—Royal Institution, 9. Capt. E. D. Lyon, "On the Mythology of India."
Saturday, 22nd.—Royal Institution, 3. Prof. Max Muller, LL.D., "On Darwin's Philosophy of Language."

THE CHEMICAL NEWS.

VOL. XXVII. No. 695.

PRELIMINARY NOTICE ON

SOME NEW CHLORINATED COMPOUNDS OBTAINED FROM ORCIN.

By JOHN STENHOUSE, LL.D., F.R.S., &c.

Pentachlororcin Hypochlorite.—In a paper published at the close of the year 1871 (*Proc. Roy. Soc.*, vol. xx., p. 77) I described a substance having the formula $C_7H_4Cl_6O_3$, to which I gave the name of pentachlororcin hypochlorite. It would appear that the constitutional formula, $C_7H_3Cl_5O_2,HClO$, then ascribed to it, is really the correct one; for I find that pentachlororcin, $C_7H_3Cl_5O_2$, can be directly converted into the hypochlorite by treatment with calcium hypochlorite, when a compound, probably $(C_7H_3Cl_5O_2)_2CaCl_2O_2$, is first formed, which, by the action of acids, yields the pentachlororcin hypochlorite. I hope ere long to be able to describe pentabromorcin hypobromite, prepared by a similar process from pentabromorcin.

Action of Ammonia on Pentachlororcin Hypochlorite.—When finely-powdered pentachlororcin hypochlorite is treated with dilute ammonia, considerable heat is produced, and, if the ammonia be sufficiently concentrated, the mixture solidifies to a mass of minute needles; at the same time a gas is given off, and a powerful odour of chloroform becomes apparent. The product may be purified by crystallisation from hot alcohol, when it forms long silky needles, which fuse at 187°. They are almost insoluble in water, but readily soluble in hot alcohol and in benzol; moderately so in carbonic disulphide, ether, and hot petroleum, crystallising out almost entirely from their solution in the latter on cooling. When subjected to analysis, this substance gave results agreeing tolerably well with the empirical formula $C_6H_5Cl_3NO$. If this be correct, the new compound may be regarded as an amido-trichlor-phenol, and the reaction could then be represented by the equation—

$$C_7H_4Cl_6O_3+2NH_3=C_6H_5Cl_3NO+CHCl_3+2H_2O+N.$$

The compound is only decomposed with difficulty by the action of acids or alkalies, being readily soluble in concentrated sulphuric acid, and precipitated again, apparently unaltered, on the addition of water.

Action of Aniline on Pentachlororcin Hypochlorite.—When aniline in excess is added to a solution of pentachlororcin hypochlorite in benzol, and the mixture allowed to stand, it deposits a new compound in tufts of colourless needles. These, unlike, the product obtained by the action of ammonia, are readily decomposed by dilute acids, leaving a colourless, crystallisable compound, readily soluble in carbonic disulphide.

Action of Calcium Hypochlorite on Orcin in Presence of Excess of Acetic Acid.—If, in the preparation of pentachlororcin hypochlorite by the action of hydrochloric acid and calcium hypochlorite on orcin in the manner previously described (*Proc. R. S.*, vol. xx., p. 77), acetic acid be substituted for hydrochloric acid, no precipitate is produced even after standing some hours. At the end of five or six days, however, the sides and bottom of the vessel will be found to be covered with colourless crystals, differing totally in appearance from the pentachlororcin hypochlorite. After being purified by crystallisation, first from carbonic disulphide, and subsequently from water, it forms long, white, flattened prisms which melt at 130°. They are only slightly soluble in carbonic disulphide or boiling water, and almost insoluble in cold water; in ether and alcohol they are very soluble, somewhat less so in benzol, and moderately soluble in hot petroleum. It is soluble in hot sulphuric acid, and is re-precipitated on the addition of water. It dissolves also readily in dilute caustic soda or ammonia, acids producing a precipitate in the latter solution, but not in the former. I have been unable to obtain any definite metallic derivatives from this compound. The results of the analysis agree with the formula $C_6Cl_4H_4O_3$, and I hope soon to be able to make out its constitution by an examination of the products of its decomposition.

Action of Sulphuric Acid on Pentachlororcin Hypochlorite.—When the hypochlorite is added to concentrated sulphuric acid, and the mixture gently heated, a large amount of gas, apparently phosgene, is given off, and the pentachlororcin hypochlorite dissolves. On pouring the solution into water, an oily body is precipitated, which solidifies, after a time, when exposed to the air, and immediately on the addition of an alkali. This reaction I am at present investigating.

THE ACTION OF THE SPECTRAL RAYS IN DECOMPOSITION OF CARBONIC ACID IN PLANTS.

THIS is a subject which has of late attracted considerable attention from Continental observers.

The assertion (by Prof. Draper, of America, and others), that a curve representing the decomposing force of the various rays corresponded to the curve of brightness, has been called in question. Timirjaseff, *e.g.*, affirmed that it corresponded to the curve of heat-intensity. And, more recently, Lommel sought to show that the rays which are most active in producing decomposition of carbonic acid must be those which are most powerfully absorbed by chlorophyll, and, at the same time, have a high mechanical intensity (heat-action). He thus inferred the red rays between B and C to be the most active. Müller adduced experimental results to support Lommel's theoretical conclusions, his mode of experiment being to expose leaves in a glass vessel at various parts of the spectrum, and then determine gasometrically the amount of decomposition.

In a recent communication to the Marburg Society of Natural Science, Dr. Pfeiffer opposes these views of Lommel and Müller, and gives an account of experiments made on the subject.

He points out that chlorophyll solutions may be obtained which give the absorption-bands, and yet show no decomposition of carbonic acid, but rather absorb oxygen. Hence it is an unwarranted inference that the rays most active in decomposition are those which are extinguished. He also shows, from an experiment in which 5·7 c.c. of carbonic acid were decomposed by an Oleander leaf of 20 square centimetres' surface in two hours, how small is the amount of work represented in the starch produced; so that, if even the yellow rays had produced the whole decomposition, a weakening or extinction of them would not be observable.

In order to determine empirically the decomposing force of rays of different refrangibility, Dr. Pfeiffer adopted the method of counting the bubbles of gas given off by a branch in water. The following is an outline of his procedure:—

Two lenses, of different focal distances, were so combined that solar rays passing through them from a heliostat issued nearly parallel and formed an image 40 m.m. diameter. The diameter of this image fell on a slit 3 m.m. broad; and the rays, then passing through a prism and an achromatic lens, formed a spectrum at 2 to 2½ metres' distance having a length of 230 m.m. and a height of 50 m.m. The weakening of the rays through absorption and reflection was reckoned at about 1-12th, but the absolute intensity was not measured. The yellow was sufficiently bright to cause pain in looking at it. The

spectrum was not perfectly pure, but proved sufficiently so for the purpose.

In the gasometric method, Dr. Pfeiffer remarks there are various disadvantages. A long exposure is required, and small errors are apt to creep in, both in this and in removing the leaves from the tube; and these errors assume importance from the small quantity of carbonic acid decomposed. The method of counting gas bubbles, indeed, does not give a perfectly accurate value for the quantity of CO_2 decomposed; still, in all circumstances where the bubbles increase, there is more energetic decomposition, and conversely, the amount of correspondence being sufficient. When a plant is giving off bubbles, the slightest shadow makes a difference, and in less than a minute the new stream of bubbles becomes constant for the new light intensity.

The plant employed was *Elodea Canadiensis*. Branches of this, 45 m.m. long, fixed to a glass rod, were placed, with cut surface uppermost, in a parallel-sided glass vessel filled with water. A pasteboard cover was applied to one side of the vessel, having a vertical slit 13 m.m. in breadth opposite the branch, and including it. The vessel was then submitted to the spectral rays, which came to it at right angles through the slit. Care was taken that, in moving the vessel to a new position, the rays should still meet its surface at right angles.

The counting of bubbles began at the yellow. After each removal, a short time was allowed for the stream of bubbles to become constant. From the yellow throughout there was in every case a continuous diminution in the number of bubbles, as the following shows:—

In yellow,	in a quarter of a minute,	22	bubbles.
,, orange next yellow	,,	19	,,
,, middle orange	,,	15	,,
,, orange next red	,,	14	,,
,, red next orange	,,	7	,,
,, red further off	,,	4	,,
,, ,, ,,	,,	3	,,
,, ,, ,,	,,	2	,,
,, extreme red	,,	1	,,
Back to yellow	,,	22	,,

In yellow,	in a quarter of a minute,	25	bubbles.
,, middle of green	,,	9	,,
,, ,, blue	,,	6	,,
,, ,, indigo	,,	4	,,
,, ,, violet	,,	2	,,
Back to yellow	,,	24	,,

(It may be observed that, where the process became very slow, counting was continued for half a minute to one minute, and then a reduction made.)

Dr. Pfeiffer next experimented by placing a chlorophyll solution in the path of the rays, and bringing the plant to the band between B and C, which, with a breadth of 10 m.m., almost entirely covered it. The number of bubbles given off here was compared with that in the bright yellow. Reckoning the latter as 100, the average for the other was 29·1.

Thus no connection is indicated between absorption of the light rays in a chlorophyll solution and the "assimilation-value" of these absorbed rays.

On the other hand, the little-absorbed yellow rays appeared most active in decomposing CO_2, and what appeared the brightest part of the yellow gave most bubbles; so that, on moving the plant even a very little on either side, and without leaving the yellow, the number of bubbles diminished. For example, the following bubble numbers were got in half a minute's exposure:—

In brightest yellow	42	bubbles.
A little towards green ..	40	,,
Back to first position ..	42	,,
In brightest yellow	43	bubbles.
A little towards orange ..	40	,,
Back to first position ..	42	,,

From a large collation of instances are obtained the following average values for the several spectral rays, reckoning the number of bubbles in the yellow at 100:—

Red	25·4
Orange	63·0
Yellow	100·0
Green	37·2
Blue	22·1
Indigo	13·5
Violet	7·1

The curve formed in accordance with these numbers agrees very nearly with the curve obtained by Vierordt in his measurement of brightness in the solar spectrum. From the culmination-point in yellow, to the middle of orange and green, they are almost alike; thereafter they diverge slightly.

Now this curve obtained from bubble numbers does not truly represent the assimilation curve. The numbers (as Dr. Pfeiffer had pointed out in a previous paper) were too high, and the more so the less carbonic acid was decomposed in given circumstances. The relation between the values for the gas bubbles, and the quantity of CO_2 decomposed, is, on account of individual peculiarities and other causes, not constant, and must be determined empirically. If, however, the proper reduction be made, Dr. Pfeiffer thinks the curve then obtained will have a still closer resemblance to the brightness curve.

Stlll, the agreement of the gas bubbles curve with the brightness curve is so close as to warrant Draper's conclusion, as to the decomposition of CO_2 in plants, that the decomposing force of the various rays corresponds in general to their apparent brightness in the spectrum.

RECIPROCAL CONVERSION OF INACTIVE TARTARIC AND RACEMIC ACIDS. PREPARATION OF INACTIVE TARTARIC ACID.

By E. JUNGFLEISCH.

In a previous paper (*Comptes Rendus*, vol. lxxv., p. 439), I described the conditions under which, by the aid of heat, dextro-tartaric acid is converted into racemic acid, and I then observed that under these conditions inactive tartaric is simultaneously formed. The further pursuit of my researches has enabled me to solve some of the questions which then arose.

Complete Conversion of Dextro-tartaric Acid.—One of first points required to be studied was the question whether the complete conversion of dextro-tartaric acid (into inactive acid) is possible, notwithstanding the presence of a large quantity of racemic acid; or that, at the temperature of 175°, a stable equilibrium takes place, which limits the production of the converted body. The dextro-tartaric acid is all converted when the action of the heat is kept up for a sufficiently long period. Moreover, when pure racemic or inactive tartaric acids are heated with water up to 175° under pressure (in sealed tubes, or in a Papin digester), I did not find in the products of this reaction any traces even of dextro- or sinistro-tartaric acids; and since an equilibrium cannot be established, except in consequence of reciprocal conversions, it is evident that the disappearance or complete conversion of the dextro-tartaric acid cannot be limited under the conditions prevailing in the above-mentioned experiment.

Equilibrium between Racemic and Inactive Tartaric Acids.—As I had found that dextro-tartaric disappears completely, it became necessary to ascertain why it is not possible by one single operation to entirely convert the tartaric acid experimented with into racemic acid. It will not be a difficult matter to prove that this is occasioned by the inactive tartaric acid, which is simultaneously produced, and which interferes and limits the reaction.

Although, as already mentioned, the dextro-tartaric acid, provided the combined action of the heat and water be kept up for a sufficiently long period of time, is completely converted into inactive and racemic acids, it is impossible to make the inactive acid disappear even by a continuous heating to 175°, because when, by the aid of water and crystallisation, the greater portion of the racemic acid is eliminated and the experiment resumed with the residue (mother-liquor) which contains the inactive acid, racemic acid is again produced, while a corresponding portion of inactive acid disappears; and when this mixture is again submitted to crystallisation, and the same course of operation repeated, the same results are obtained; but, as soon as the mixture has attained a certain composition, no more racemic acid is formed when a portion only of that present is eliminated. When pure inactive acid (prepared by a process to be presently described) is similarly treated, equal results are obtained; that is to say, it is at each operation partially converted into racemic acid, but (and I must call particular attention to this fact) more and more completely so at each repetition of the operation. When racemic acid is heated under precisely the same conditions, it is partly converted into inactive acid, the production of which ceases at a certain moment, notwithstanding that the action of the heat be kept up. When the racemic acid is eliminated by crystallisation, while the very soluble inactive acid is left in the mother-liquor, and the thus purified racemic acid again submitted to the combined action of heat and water in a closed vessel some inactive acid is again formed, and thus the operation may be several times repeated. This experiment always yields the same results, whether made with the artificially-prepared racemic acid (from dextro-tartaric acid), or with the racemic acid from Thann (occurring in certain kinds of grapes grown there). When the experiments just alluded to are conducted at temperatures between 155° and 170°, instead of heating to 175°, I found that the quantity of inactive acid formed or remaining (*subsistant*) increases, while the quantity of water present also exerts a decided influence, because the larger the quantity of water present, the larger becomes the proportion of inactive acid in the non-modifiable (not further convertible) mixture; but my experience in reference to this point is not yet very complete. It appears, however, to be an established fact that inactive tartaric and racemic acids are reciprocally convertible one into the other; but this conversion is limited, and has a tendency to assume a state of equilibrium which varies according to circumstances and is most influenced by temperature.

Preparation of Inactive Tartaric Acid.—The above observations may be applied to the easy preparation of large quantities of inactive tartaric acid, a substance first discovered by Pasteur, but so rare and little known that up to the present time it has certainly been often overlooked. When, instead of being heated to 175°, dextro-tartaric acid is heated in an autoclave for a period of fully two days up to 165° along with water, just as is done for the preparation of racemic acid, the latter is met with only in small quantities, while the larger proportion of the dextro-acid has disappeared. The racemic acid is first eliminated as much as possible from the liquid by crystallisation, and water is next added to the fluid, which is then divided into two equal portions; one of these is very carefully saturated with potassa, and this having been done is poured into the other portion, so as to form an acid salt. The acid potassa salts of the dextro-tartaric and racemic acids are not very soluble in cold water, while the inactive potassio-tartrate is very soluble, so that, when the liquid is partly concentrated by evaporation, the two first-named salts crystallise, while the third is deposited from the sufficiently-evaporated solution on cooling. This salt is purified by re-crystallisation; but as it is usually coloured in consequence of the decomposition of a small quantity of tartaric acid (owing to the high temperature), it is best first to add to the solution a few drops of acetate of lead, and then to treat it with sulphuretted hydrogen; the sulphuret of lead withdraws the colouring matter, and on filtration a clear and colourless liquid is obtained. The preparation of inactive acid can be carried on simultaneously with that of racemic acid by repeating the action of the heat a sufficient number of times to obtain the desired quantity of racemic acid, and to treat the mother-liquor thereof for the potassa salt of the inactive acid, which may by that means be obtained in quantities of from ½ to 1 kilo. of that salt, which may be converted by double decomposition into a lime salt, and decomposed by sulphuric acid, or into lead or copper salts, and decomposed by sulphuretted hydrogen. Professor Pasteur having kindly given me some of the inactive tartaric acid obtained by him in his experiments, I have been enabled to prove the identity of the two bodies. I intend to investigate this substance further. The conversion of inactive tartaric into racemic acid, and consequently into two tartaric acids possessed of double—right and left handed—rotatory power, appears to me interesting, as elucidating the ensemble of phenomena belonging to molecular dissymmetry. My observations are not absolutely in contradiction to the views now held on the origin of the rotatory power, because the inactive tartaric acid, which has been the starting-point, was obtained from dextro-tartaric acid, a native compound, so that it may be considered that the rotatory power of the latter has only been lost sight of, and has returned. We cannot, therefore, rigorously conclude on the possibility of reproducing by synthesis bodies possessed of rotatory power, and therefore I have gone farther, and hope shortly to lay before the Academy a communication of the results I have obtained by producing the complete synthesis of racemic acid by means of ethylen and cyanide of potassium—that is to say, artificially-made compounds obtained from the elements. —*Comptes Rendus.*

THE MANUFACTURE OF SULPHURIC ACID.*

By J. McCULLOCH.

(Concluded from p. 126.)

There are two methods at present in use on the Tyne for the denitration of the nitro-sulphuric acid; the Glover towers, and denitration by steam. The following is the system pursued by the steam process.

A cast-iron pipe 9′0″ × 3′0″ is lined with lead, and a lining of half thick bricks with pipe-clay as mortar; this is set on end and packed with flints, and a fire-clay pipe is connected between the top of this column and the chamber, a steam-pipe being introduced at the bottom; the nitro-sulphuric acid entering at the top trickles from thence down through the openings in the flints, where it is met by the ascending steam and reduced from 148° to about 104° T., and is raised in temperature from 60° to about 300° F., which on cooling down gives acid of about 128° T.

The acid as run from these columns generally contains only the faintest trace of nitrous compounds.

I have conducted chambers on this principle for a number of years, and for the last three or four years using about 24,000 tons of pyrites annually the average percentage of nitre has not been more than 3·5 per cent. The beauty of this system is that there cannot be a break down, as the denitrating columns can be detached from the chambers in a few minutes, and the chamber kept working by the addition of an extra supply of nitre.

The only drawback to this system at the present time is, that from three to four tons of coals are required per twenty-four hours to boil up as much weak acid as is required to absorb the hyponitric acid obtained from the conversion of twelve tons of sulphur into sulphuric acid.

The other system is the Glover towers; this no doubt is

* Read before the Tyne Social Chemical Society.

a very good system, but there are two serious drawbacks to it; first, the danger of the packing or lead giving way, necessitating the laying off the chambers; second, the re-absorption to a certain extent of the nitre in the columns. This is not such a serious obstacle where the acid is used over again in the Gay-Lussac columns, but where the acid is run direct from the denitrating columns to the decomposers, the loss must be very serious.

No doubt the saving in nitre is very great in manufactories where they have had no apparatus at work for the recovery of the hyponitric acid, but where they have had the first named system at work, and changed to the latter, I think it will be found that the percentage of nitre used on the sulphur will be considerably increased.

Let us examine the two systems closely. On starting a set of chambers, in the case of the steam columns, the steam and acid are turned on five or six hours before charging the burners with pyrites, the consequence is the chamber is entirely filled with nitrous fumes and vapour of steam, ready to begin work on the entry of the sulphurous acid.

I have charged burners at 6 a.m., and at 6 p.m., or twelve hours after, the drops at chambers have been at 130°; chamber a ruddy colour, and the following day the extra quantity of nitre could be taken off. The floor of the chamber was, of course, covered with acid to commence with. In the case of the Glover towers it is at least three or four days before the column is hot enough for denitrating purposes; there are no nitrous fumes in the chamber to start with, consequently there is a loss of sulphuric acid, and for a week at least an extra quantity of nitrate of soda is required.

In some works the nitrous fumes from the pots are conveyed through a separate pipe to the chambers, thus passing a current of pure sulphurous acid through the denitrating columns. This, I think, will not pay for the extra cost, as it is found in practice that heat alone will not drive off the nitrous fumes entirely. The nitro-sulphuric acid must be considerably weakened before it can be thoroughly denitrated.

A number of experiments were tried which gave the following results:—Five separate samples of weak acid were taken at 113° T., and on being calculated into oil of vitriol was found to contain 0·24 per cent $NaONO_5$.

These samples were passed separately through acid pans and evaporated from 113° to 152° T. at a temperature of fully 300° F.; on being cooled down to 60° F., and again calculated into O.V., the same acid was found to contain 0·22 per cent $NaONO_5$.

Another experiment was tried with a Glover tower, which was at the time only used as a cooling tower, owing to the absorbing plant not being ready. The weak acid at the top was at 110° T., and contained 0·32 per cent $NaONO_5$; after having passed through the tower it was found at the bottom to be 147° T., and contained 1·51 per cent $NaONO_5$. This, I think, goes a long way to prove that more than heat is required, and that the hyponitric acid is re-absorbed in the Glover towers.

The acid used for absorbing the nitrous fumes passing from the chambers should not be less than 148° T., and as cool as possible, although were it to be as high as 110° at the top of the absorbing towers, its power for absorbing would not be much affected, the column being kept in a very cool state by the cold ascending current from the chambers. Acid introduced at the top at 120° F. will be found, when drawn off at the bottom, to be as low as 60° F.

Much difference of opinion exists as to the erection and working of sulphuric acid chambers, such as the strength of the lead employed, the size of the chambers, necessary draught, strength of steam, &c.

In building a set of three or four chambers, the two first chambers should be of about 7-lb. lead, and the remaining chambers in the set about 6-lb. lead. The side straps in some works are bound to cross rails in the chamber framework, or nailed to the uprights. Both plans have been found objectionable, as on the stretching of the side sheets, the straps are either torn off, or should the lead be thin, pieces will be torn out of the solid sheets. The method which I have followed for years, and which I have found to be the best, is to burn a strap on each side of the chamber upright and clinch the two together in front, thus keeping the sides upright, and at the same time allowing the lead to sink or stretch, without putting a strain on either sides or straps. An objection may be raised that there is a danger of the sheets breaking away at the top; I have never known this to occur.

In working chambers, some prefer a large number of small chambers; others, a smaller number of large chambers. In small works where they have, say, only twenty or thirty burners, it may be convenient to have their chambers small, so that they may be able to lay off one or two for repairs; but in a large works I know of no point in their favour to recommend the erection of a large number of chambers, say, from 60′0″ to 100′0″ long, instead of from 120′0″ to 180′0″, with a corresponding height and width. Were the sides of the chamber found to condense more acid than the centre, it would be quite a different matter.

On that subject I agree with Muspratt, who says:—"Is it absolutely necessary that there should be a surface for condensation? Is this necessary in all cases, natural and otherwise? Does the rain cloud, which, perhaps, in one half hour will come down in a heavy shower, require a surface for condensation? If it did, possibly rain would be more manageable; but this watery vapour needs no cold surface; it condenses into water, losing the vaporous, and assuming the fluid state, without any assisting cold surface. And if this rain cloud be capable of so condensing, is it not possible for the like physical reaction to take place within a vitriol chamber? But further. Is it not probable, or rather certain, that the sulphuric acid in the chamber never was in the state of vapour. Sulphuric acid requires a heat of 620° to convert it into vapour. The highest point of heat a chamber could attain could be no approach to this; probably the heat of a chamber will not exceed 212° in the hottest part where the gas enters. Is it not possible that every atom of sulphuric acid produced passes from sulphuric acid gas to liquid sulphuric acid at once the instant it is formed—that the chamber is filled with these newly-formed particles—that these float about, and, like globules of running mercury, they gradually coalesce with each other, until at last they form a particle like a rain drop, sufficiently heavy to resist the sweeping influence of the currents which exist in the chamber, and that, finally, this drop falls into the acid on the floor of the chamber. Although it is impossible to see the process, and so prove the truth of this opinion, a very good inference of its justness may be drawn from an experiment which was tried on a chamber. A strip of lead about 3″ wide was attached to the inner side of the chamber, in such a manner that it resembled a gutter or spout in an inclined position, one side of this gutter being formed by the chamber side, the other by the strip. This was placed about 2 or 3 feet above the acid in the chamber, and was about 9 feet long. In consequence of this position, the whole of the acid which formed or condensed on that side of the chamber above the strip would flow along it, and be carried by a small tube passing through the wall of the chamber into a vessel placed on the outside to receive it.

"If the liquification of the acid took place almost wholly on the side of the vitriol chambers, a pretty rapid current of acid must have flowed along this arrangement, but this was not the case; instead of, as might have been expected, a constant stream passing along it, nothing more than isolated drops issued, probably at the rate of six drops a minute, an utterly insignificant quantity, when compared with the amount of acid which must have been formed within the space over which this strip had the command. In fact, any observant manufacturer must, after a little attention to the subject, come to the conclusion that such is the case; that condensation goes on chiefly within the

space of the chamber, although a small portion may condense on the walls; for when the acid particles are floating about in the chamber, driven hither and thither by the various currents which must exit—some must attach to the sides and flow down into the acid already at the bottom, adding to the amount already formed. But the argument remains that all the acid is not brought to the liquid state by this means; that, in fact, the quantity so formed bears a very small relation to the whole.

"To many this will be already palpable, but evidently not to all, inasmuch as these strange abortions of chambers are not by any means as yet extinct, but still remain a testimony to the ignorance of many of our manufacturers. It must be apparent, that if anything more than the usual amount escapes from the chambers, either they are badly worked or overworked. If the first should be the case, more attention must be directed to them to find out the error. If the second suggestion be correct, then as the chambers have more material introduced into them than they can properly work, the amount of sulphur usually burnt must be decreased, until the maximum amount which can be burned with a beneficial result is found. It needs little argument to prove that the working space included in a tunnel could have been included in the chamber at much less expense."

Some acid makers have the idea that small chambers are necessary for the proper mixing of the gases; this idea will not, however, bear investigation, for between the currents which exist in the chamber, from condensation, draught, and the law of gaseous diffusions being in force, it is impossible that free oxygen, binoxide of nitrogen, hyponitric and sulphurous acids can exist separately, however large the chamber may be.

In working chambers much has been said about the rule of three and rule of thumb methods of ascertaining the quantity of nitrate of soda contained in the sulphuric acid. Much as I admire the rule of three, I think that a rough and ready method of calculation will oftentimes give the manager quite as satisfactory results, is much better than spending time in the laboratory which might be more beneficially employed, and it frequently occurs that the expected rule of three merely proves a rule of thumb method after all. Let us examine the subject fairly and practically. For a number of years I worked a set of chambers, which, when wrought with nitre alone never took more than 9 per cent nitre, burning seven tons of sulphur per twenty-four hours from pyrites. When using the Gay-Lussac towers and denitrating the nitro-sulphuric acid by steam, I used 3·5 per cent nitre, and passed 52·497 lbs. of acid through the denitrating columns per twenty-four hours.

The acid I have had tested repeatedly, both by the urea and permanganate processes, and it was always found to contain more than 6 per cent of $NaONO_5$. Now if we take the acid as containing 6 per cent, it will give us 3,149 lbs. of $NaONO_5$, which, when added to the 3·5 per cent of nitre used from store would equal 23·5 per cent of nitre on the sulphur charged. On trying to reduce the quantity of acid passed through the denitrating column, the chambers began to get pale, and I had at once to put an extra "run" on them, thus showing that there could not possibly be the quantity of $NaONO_5$ in the acid as shown in the analysis.

All that is needed in working chambers is an approximate idea of the quantity of $NaONO_5$ contained in the sulphuric acid, and by putting a little hot water into the acid from the absorbing towers, the manager can at once tell whether the acid is "rich" or "poor," and take measures accordingly.

I have here a ground plan of six chambers, somewhat similar to a set which I worked for five years (minus the Glover towers); the working chambers never attaining more than 160° F., and the receiving chamber 90° F. These chambers, measuring 180′0″ × 21′0″ × 20′0″, were worked at 28 cubic feet per pound of sulphur per twenty-four hours, and gave an average production of 284 per cent O.V. on sulphur charged.

There are forty burners attached to the six chambers, divided into two sets of twenty burners each. The gas from the first twenty burners passes through a Glover tower into No. 1 chamber, traversing which it enters No. 2, thence through a damper into the draught pipe "A," which carries the gas into No. 5 chamber, thence to No. 6, which it leaves by the draught pipe "B," through two dampers, "C C," to two absorbing towers. The advantage in having two dampers placed here is, that in case one column requires repairs, the damper can be shut, and the other column will work the six chambers in the interval.

The gas from the second twenty burners passes through a Glover tower into No. 3 chamber, thence to No. 4, leaving which it passes through a damper into the draught pipe "A," pursuing the same course as the gas from chambers Nos. 1 and 2. The advantage in working chambers on this system is, that although there are only six chambers the gas from each set of burners passes through four of them, thus making the six chambers almost equal to two sets of four chambers each.

There is also another advantage in the case of repairing either Glover towers, or Nos. 1, 2, 3, or 4 chambers; the damper at the end of 2 or 4 can be put down, when there is a complete set of four chambers in either case. If necessary heavier charges of pyrites can also be introduced into the twenty burners that are working, as there will be a larger chamber space.

I have found over many years experience, that the best draught to work chambers with, is—when the manhole door is opened, the gas as it were did not know its own mind; it would fain come out, but it would just as soon stop in. This happy medium cannot, however, be always attained, as the chamber draught must be regulated to suit the burners. To obtain a good production, the strong chamber drops should not be kept above 130° or 135°, the weak chamber about 100° T., and the steam should on no account be high pressed; it should never be above 12 lbs., 11 lbs. I consider a good standard at the boilers with the allowance of a pound either way.

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY.

March 12th, 1873.

Joseph Prestwich, Esq., F.R.S., Vice-President, in the Chair.

The communications read included the following:—

"*On Solfataras and Deposits of Sulphur at Kalamaki, near the Isthmus of Corinth.*" By Prof. D. T. Ansted, M.A., F.R.S., F.G.S.

After noting the traces of volcanic action east of the Pindus chain, the author described the Solfataras and sulphur-deposits of the neighbourhood of Kalamaka as furnishing indications that there is even now a real though subdued volcanic energy in this part of Europe. At this place, about three miles east of the Isthmus of Corinth there is a series of cream-coloured and grey gypseous marls, broken by narrow gorges and fissures. These marls, the stratification of which is much disturbed, are loaded with sulphur. In the principal gorge there are several lateral fissures, forming caverns, communicating with the interior by deep cracks; these caverns are completely lined with crystals of sulphur and other volcanic minerals, and are rendered inaccessible by the large body of hot stifling vapours constantly emitted through them. The temperature of this vapour, where it can be reached, is about 100° F., but the floor of the caverns is too hot to stand on even near the entrance. The author is of opinion that the rocks in this gorge might be profitably worked for sulphur. Similar phenomena occur in several other places within about a mile of

the ravine described; and the author was informed that this was the case also several miles further to the east.

The author adverted to other signs of volcanic action to the west of these Solfataras, and especially to the structure of the Acropolis of ancient Corinth, and inferred that lines of volcanic action parallel to the spurs of the Alps of which Etna and Vesuvius, and Santorin are the modern vents, ranged far to the north at no distant period.

Mr. W. W. Smyth wished that the author had drawn a more distinct line between the tertiary beds containing sulphur and those of still more recent origin. The beds near Corinth reminded him much of some in Transylvania, and he was anxious to know whether the direction of the fissures or other phenomena indicated any great disturbance of the strata.

Prof. Ansted, in reply, mentioned that the fissures ran approximately north and south, and were as nearly as possible parallel. He considered that they were connected with the disturbances which have taken place in comparatively recent times along the eastern coast of the Morea. The sulphur, which usually occurs in small globular masses in gypseous beds, was found in these Solfataras in crystalline form, and in connexion with the fissures from which the heated gas issues. There was therefore a marked difference in the manner of its occurrence both in Italy and Greece. In Greece the sulphur deposit in nodules was found on the west of the principal chain of mountains, and the crystalline sulphur on the east. In Italy the crystalline sulphur is limited to the vicinity of Vesuvius, and the nodules are abundant both in Sicily and on the east coast of the main land.

"*On the Origin of Clay-Ironstone.*" By J. Lucas, Esq., F.G.S.

The author commenced by giving a general view of the varieties, chemical composition, and mode of occurrence of clay-ironstone, and suggested that the formation of all the bedded varieties may be explained by the supposition that they originated in peaty or non-peaty lagoons on the alluvial flats of the deltas of the carboniferous formations, which would present semi-terrestrial conditions, that is to say a surface exposed to the air, but subject to be covered by floods. Carbonic acid formed in the lagoons from decomposing vegetable matter, meeting with protoxide of iron in solution, would unite with it to form carbonate of iron, which, with the mud of the lagoon, would produce clay-ironstone. Thus, in the author's opinion, the beds of clay-ironstone, like coal-beds, mark terrestrial horizons. The author supported his views by reference to various sections, and also cited the occurrence of what he regarded as an analogous phenomenon on a small scale in some mud obtained from the shore between Redcar and Saltburn.

Prof. Ansted thought that the explanation offered by the author, though satisfactory for instances of limited thickness and confined area, was not equally applicable to the far larger deposits, such as those in America, extending over hundreds of square miles, and many times as thick as those described. The beds had by some been considered as due to segregation subsequently to their deposit; but this view also seemed hardly such as could be generally accepted. The deposits of ironstone varied much in character, sometimes consisting of layers of distinct nodules, and in some cases of continuous bands. The origin of each of these classes appeared to him to have been different, and in some of the coal-deposits the ironstone bands were present on a more extended scale than seemed consistent with the author's theory.

Prof. Ramsay thought that the paper exhibited considerable ingenuity, and that the examples given by the author were intended by him to be equally applicable to large areas. The estuarine character of much of the coal-deposits was an acknowledged fact; and the theory proposed by the author was quite in accordance with such a state of things. He did not agree with him that ironstone was never deposited in marine strata, as they occurred in the Yoredale beds and in some Liassic beds. As to the deposits of ironstone in fresh water, he referred to those still taking place in some of the Swedish lakes.

Mr. Forbes, whilst admitting that in many instances clay-ironstones had been deposited in circumscribed waters or shallow lakes, as is the case with the lake iron-ores in Sweden now actually in process of formation, pointed out that some of the largest clay-ironstone deposits in England, those of the Yoredale series, contained marine fossils in abundance. On chemical grounds it is not clear in what state of combination the author imagines the iron to be held in solution previous to having been, according to him, converted into carbonate of iron, by meeting with the carbonic acid formed in the lagoons from decomposing vegetable matter; and further, the mere fact that the Saltburn mud effervesced with nitric acid after having been bottled for some days, must not be regarded as necessarily proving the formation of carbonate of iron in it.

Mr. Charlesworth called attention to the nodules of ironstone which were found in the coprolite diggings in Suffolk, as to the origin of which little was known. The banding in the interior of these nodules was posterior to their formation, as was evinced by its following the contours of the exterior, and even of lithodomous borings in them.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

The following is the Inaugural Address of Dr. Lunge, the President for the present Session:—

In rendering you my thanks for conferring upon me the distinguished honour of election as your President for the coming session, I do not see any reason for deviating from the custom of my predecessors in this office, to pass shortly in review the labours of the past session. When preparing to do so by re-perusing the reports of our *Transactions* throughout the last winter, I was struck in the first instance by the observation, that, if the papers contributed by our members were few in number, most of them certainly were very valuable, partly by their own contents, and partly by the suggestions that might be derived from them for a further development of the investigations then commenced. It cannot but be the case in a chemical society of a local character, like our own, that the subjects taken up by our members are almost exclusively derived from technical chemistry, and more particularly from such branches of this science as are the speciality of this district. So far from regretting this circumstance, I believe that this is just as it ought to be. In manufacturing on a large scale, problems constantly arise which are almost unknown to the metropolitan student working in his laboratory, and the investigation of such problems is not only of a practical, technical, and economical importance, but it cannot fail to have substantial results of a purely scientific character. This will be all the more assured, of course, if those who take such matters in hand do not confine themselves merely to work on till they have remedied certain irregularities or defects found in manipulating chemical reactions on a large scale; but if they continue their researches till they completely elucidate the *rationale* of the regular process, as well as of any deviations from this observed by them, they will thus, in one and the same act, put themselves on a scientific basis, and aid even their immediate purpose infinitely more than by merely confining themselves to looking at the matter from the manufacturer's point of view. It is quite certain that we cannot do better than encourage to the utmost all efforts tending in this direction; and on this account we have reason to be specially thankful to Mr. Moorhouse for his paper "On the Action in the Black Salt Pan and Carbonating Furnace." The second point which struck me came out very prominently just in connection with this paper, although it appeared also on all other occasions, viz., the way in which both the utility

of the papers read before this Society is enhanced, and the general interest in them is kept alive by the discussions following the reading of them. I believe I am correct in stating that the facts elicited in discussion, partly from the authors of the papers and partly from others, often nearly approach the papers themselves in value, and may sometimes even exceed them in that respect. I must certainly congratulate the Society upon the plan it has been following, of having the discussions reported and printed *in extenso*, and I hope that this plan can be even improved by regularly arranging the discussion upon any paper to follow at the meeting held next to the reading of it, without, of course, excluding any remarks that may spring up directly after the reading. It has been proposed, as an alternative to this plan, that the papers should be printed and in the hands of the members before the day of the meeting at which they are read, so that a discussion could with advantage succeed them at once; but apart from the great difficulty of getting authors to supply their contributions such a long time before the meeting as would be necessary for printing and distributing them, it also seems hardly fair to me that an author should be deprived of the freshness of the impression to be produced by his work, by the fact that everybody knows beforehand what he is going to say; the reading itself would then be nothing but a ceremony which might be dispensed with altogether, and that surely is not desirable.

The value of a discussion was proved very distinctly in connection with the very important paper, contributed by Messrs. Pattinson and Freire-Marreco, "On the Residual Sulphur in Purified Coal-Gas," with the translations of Fresenius's methods for analysing superphosphates; and last, not least, when the two papers were read which in their entirety constitute the most important contribution to technical chemistry sent forth by our Society last session, viz., the description by Messrs. Gibb and Gelstharpe of their new mechanical calcining furnace, and of their new process for obtaining a precipitant and manufacturing alkali from waste solutions of copper extraction. As you no doubt all remember the very great interest awakened by these papers in the Society, and the universal appreciation they found amongst us, I need not say anything more about them. No discussion has as yet been opened upon the paper with which our last winter's meetings closed, viz., that by Messrs. Clapham and Ball, "On Bachet's Method for Manufacturing Caustic Soda." We shall open our practical work with that task for which the interesting and suggestive paper referred to will no doubt give ample opportunities.

In turning from what we have done to what we may do next, it seems to me as if there were quite unusual opportunities for our own members of both benefitting themselves and others by investigating the new processes constantly coming out in the wide range of alkali manufacturing. I do not think that at any previous time such a host of new processes has been proposed in that branch of technical chemistry. For the last two or three years one patent has followed another in rapid succession; and although we are quite used to finding a very few grains of fertile seed among a great heap of chaff, where patents are concerned, yet there were such great expectations held out of complete revolutions in alkali-making, even by thoroughly practical men, that it quite took away one's breath. What between Messrs. Hargreaves, Young, Weldon, and Deacon, not to mention any others, nearly all the time-honoured plant of alkali-works seems to be doomed to destruction. No more acid chambers, nitre ovens, Gay-Lussac towers, decomposing pans, chlorine stills, condensers, bleaching-powder boxes, as we all know them; and now Messrs. Gibb and Gelstharpe want even to do away with our very stronghold, the ball-furnaces. Somehow or other the great revolution has not yet been accomplished; the old plant is still in existence everywhere, only augmented here and there by an appendix, according to Weldon or Deacon. But it would be idle to deny that very likely a great change is really impending, when the chaos of inventions and proposals will have been cleared up, and just at this point the work of our Society ought to make itself felt. The clearing up of that chaos will be an immensely tedious and costly process, if it is to be done exclusively by the rule of thumb, by putting up plant in twenty factories, and trying whether in the long run it "pays" or not. Most certainly that stage must also be gone through; but it can be shortened and cheapened very much indeed, if the new processes are thoroughly watched and followed out with a scientific spirit by those set to superintend them; and the latter, when communicating their results to this Society, will most assuredly not only benefit others, by either saving them needless expenditure of time and money, or encouraging them to go in for a real improvement, but, on the other hand, they will be benefitted to no small extent by the discussions, which will in many cases throw a flood of light upon points which are dark to them, and which have puzzled them for a long time, and they will no doubt receive many a suggestion amply repaying them for the trouble they have bestowed upon preparing their papers for this Society. This is so self-evident that I surely need not say another word in commendation of the practice of communicating the results which our members may find in working any new processes they may be using. Nobody can be more useful in this respect to the Society than a great many of our junior members, who personally superintend the introduction and working of such processes, and I trust they will come forward liberally this session with communications of the observations they have made and the results they have obtained.

Very much in the same direction tends a proposal which has been made during the last few months, and which has been most warmly commended by one of our own members, viz., the formation of an Association of Chemical Manufacturers, with yearly general meetings to be held in the centres of chemical industry turn by turn, and with frequent meetings of the local sections. Our own Society cannot in any case merge in such an Association, because, after all, its scope is somewhat different from that of purely technical chemistry; for even though, from our local circumstances, the latter will always form the chief, yet it will not and ought not to form the exclusive, subject of our "Transactions;" and, moreover, our Society ought to place even such manufacturing details as are submitted to it, and discussed among its members, into an atmosphere of scientific research, which in an Association of Manufacturing Chemists would certainly recede into the background. I have already stated the truism that the practice of manufacturing itself will ultimately gain very much by the treatment of its details in a scientific spirit. From this reason the presence amongst us of chemists, other than manufacturing ones, is of the greatest possible benefit, and I believe we shall have to try utilising their theoretical knowledge more than we have hitherto done. But so much is certain, that an Association such as proposed would be a most beneficial thing for all concerned; and I am sure I am expressing the thoughts of the Newcastle Chemical Society in general, if I express my best wishes for the success of the proposed Association, and my hope that our individual members will further it to the best of their powers.

You will, perhaps, pardon me if I follow up these general observations with the description of a new process for manufacturing alkaline carbonates, for which I took out a patent some years before the great tide of new processes set in, which, however, was not carried beyond the first term of three years. I must premise the following remarks. The process was a practical success, not only in the laboratory, but on a moderately large scale, but it was never carried out so as to become a current-going manufacture. The reasons for this do not concern us here, but they were foreign to the technical character of the process, and had nothing to do with its practical success or failure; the same reasons led also to the abandonment of the patent. As practical men most of you will readily under-

stand why I did not, under such circumstances, think it wise on my part to draw public attention to my process, till it should have been carried out on a large working scale, and practically introduced as a working concern; but this, of course, was hardly to be expected at all, when the patent had lapsed. From this circumstance, I dare say, very little notice has been taken of my process, without any judgment being given thereby upon its merits; and now that my individual interest in it as a patent has ceased long since, I am encouraged to give it forth to the world, in the hope that some parts of it at any rate may give suggestions, or form starting-points for new inventions and improvements in other processes. I have no doubt that other parts again will meet with your criticism, and I am myself conscious of some weak points, but I shall not only not resent any critical remarks, but I distinctly court them, If, by giving in such manner greater publicity to my proposal, I somewhat increase the chaos I have spoken of before, it is with a view of supplying a little more material out of which ultimately a perfect alkali-making process may be evolved. I must also remark that, although in the following description I am exclusively speaking of sodium compounds, yet everything said about them equally applies to potassium compounds. This is almost a matter of course, and it has been borne out by experience, at any rate in laboratory experiments.

The first idea of my process was given to me by a proposal emanating from the well-known Professor Wagner, the author of those most valuable annual reports on chemical technology published in German. Wagner had for a considerable time past given a great deal of attention to the "baryta industry," and had also tried to introduce it within the circle of alkali-making. It is well known that solutions of sodium sulphate cannot be completely decomposed by barium carbonate, whatever the temperature and the degree of concentration may be. Wagner found, however, that barium bicarbonate acts differently, and based upon this a proposal for a new method of converting sulphates into carbonates of sodium and potassium. This prescription was to stir up barium carbonate in water, and conduct a current of carbonic acid through the milky liquid till it becomes clear, barium bicarbonate being formed; to this he added an equivalent quantity of sodium sulphate, and thereby obtained barium sulphate as a precipitate, and a solution of sodium bicarbonate. Later on he found that not the whole of the barium carbonate need be converted into bicarbonate in order to make the decomposition of the sodium sulphate complete. Dr. Hofmann, in his report on the International Exhibition of 1862, remarks, with reference to this proposal, that the celebrated French alkali manufacturer, M. Kuhlmann, had not found it to be practicable on a manufacturing scale, but had got better results by working under a pressure of four or five atmospheres. Evidently Kuhlmann did not pursue his experiments with Wagner's proposal much further, because such a pressure would be both awkward and costly to maintain on that large scale, which is the rule in alkali-making; for this reason alone, the process, as it then stood could never have been expected to supersede Leblanc's process. There are, however, other drawbacks to Wagner's proposal, which must be quite evident to any practical manufacturer, and must deter him from carrying it out. The solution of barium bicarbonate is at the best a very dilute one, and of course correspondingly so the resulting solution of sodium bicarbonate; this would produce an expense for fuel in boiling down the liquids which must be fatal to the process. According to Gmelin, 1 part of barium bicarbonate is soluble in 830 parts of water. This proportion is somewhat improved, but remains still very unfavourable, by following Wagner's later proposal to convert only a portion of the baryta into bicarbonate; how much is not stated. The favourable effect of great pressure observed by Kuhlmann admits of an easy explanation, since, under pressure, water dissolves a larger proportion of barium bicarbonate. Apart from the expense of fuel for evaporation, such dilute solutions require an immense amount of plant and space for manipulating with. Then, again, it is clear that a large portion of the carbonic acid will pass through the liquid without being absorbed and will be lost; and a most serious obstacle to the whole proposal is that the whole obtainable quantity of native barium carbonate (witherite) is extremely trifling in comparison to the immense extent of alkali-making. So long as the proposal was not complemented by an easy and cheap method of recovering carbonate from sulphate of barium it was entirely barren and useless.

Now, in thinking over these various drawbacks, and considering how they could be avoided, I at last hit upon a combination of various reactions, which seemed to me to form a complete cyclus, and to lead to an economical and practicable solution of the problems of utilising the reaction between barium bicarbonate and sodium sulphate.. In the first instance, instead of beginning by making a solution of barium bicarbonate and adding sodium sulphate thereto, I began by making a strong solution of the latter (commercial sulphate of soda) at the ordinary temperature, say 1 part of sulphate to about 12 parts of water. In this I suspended barium carbonate, but not the native witherite, of which a very large excess would have been required, but an article artificially prepared in a manner to be described hereafter. Through this mixture I sent a current of carbonic acid, obtained in any suitable way, but the purer the better. I will call the vessels in which this reaction takes place "converters." Each converter ought to be provided with an agitating shaft, in order both to keep the barium compounds suspended throughout the whole contents of the vessels, and to divide the current of carbonic acid into the smallest possible bubbles. For the latter purpose, any further suitable and usual means might be employed. Each particle of barium carbonate as it is converted into bicarbonate, and thereby becomes soluble, must instantly act upon the sodium sulphate present in solution, the result being the formation of sodium bicarbonate and barium sulphate. The former, being a soluble salt, remains in solution; the latter, being insoluble, is precipitated. Since, therefore, the barium carbonate, as soon as it is generated, is instantly removed again from the liquid by being converted into insoluble sulphate, the liquid is directly after again ready to receive a fresh quantity of barium bicarbonate, which in its turn is removed forthwith as sulphate, and thus the reaction goes on continuously till there is nothing in solution but sodium bicarbonate and any soluble impurities of the original sulphate of soda employed; the precipitate, on the other hand, containing an exact equivalent of barium sulphate and any employed excess of barium carbonate. In the case of artificially prepared, *i.e.*, precipitated barium carbonate, it is not necessary to use more than the quantity required by theory; but if native witherite be used, at least four times the theoretical quantity must be taken. A very trifling quantity of barium bicarbonate may remain dissolved; but it is completely removed during evaporation, when the second equivalent of carbonic acid is driven off, and barium carbonate falls down. My theoretical reasoning was completely borne out by the practical test of experience. Starting with a few ounces, and proceeding to several hundredweights in one operation, I always found that I could convert *all* sodium sulphate into bicarbonate, and that, if the carbonic acid was tolerably pure, and was employed in a strong current, and if the liquid was well agitated, three or four hours sufficed for the completion of the reaction. I always worked at the ordinary temperature of the air, and under no extra pressure; but in working on a continuous manufacturing scale, if my arrangement of apparatus were adopted, there would be in the first converter a pressure of about 15 lbs. to the square inch, which would be decidedly beneficial to the operation, without causing any practical working difficulty to speak of. In my patent specification, I of course provided for all manner of things, such as the employment of "scrubbers" in the place of "converters"

with agitating shafts; but, in practice, I always used the "converter" as described, and I still think it the best means of working. It need hardly be mentioned that the time for stopping the reaction can be most readily ascertained by taking a sample out of the converter from a pet-cock, getting some clear liquid from it by filtration or subsidence, and trying, by a solution of barium chloride, whether any more sodium sulphate is present. Nor is it necessary to dwell upon the separation by settling and washing of the dissolved sodium and the precipitated barium compounds, this operation being a very easy one, as the precipitate is of a very dense nature.

(To be continued.)

MISCELLANEOUS.

Pyrology.—Major W. A. Ross, who read a paper on this subject before the Royal Society (see Chemical News, vol. xxvii., pp. 67, 78, 87), is preparing a volume of some 500 pages on the same subject. The work will be published by Messrs. E. and F. N. Spon.

The Royal Polytechnic.—The subject of Prof. Gardner's new lecture at this institution is "Fuel." The lecture is fully illustrated by experiments, and contains much valuable information and many useful hints on a subject of present importance. An interesting lecture entitled "The Worlds Above," is illustrated by some peculiar optical, spectral, and dioramic effects, invented and adapted by Dr. Croft, one of the directors of the institution.

London International Exhibition, 1873.—The fifth meeting of the Committee on Surgical Instruments and Appliances took place on the 18th inst., at the Royal Commission Offices, Gore Lodge. The following members were present:—Mr. Cæsar H. Hawkins, F.R.S., in the chair; Mr. W. White Cooper; Mr. H. J. Domville, C.B., M.D.; Dr. Arthur Farre, F.R.S.; Dr. G. T. Gream; Mr. J. Hilton, F.R.S.; Mr. J. Hinton; Mr. R. Liebreich; Mr. J. Luke, F.R.S.; Mr. A. E. Mackay, M.D.; Mr. J. Marshall, F.R.S.; Dr. W. S. Playfair; Mr. E. Saunders; Mr. E. Sercombe. The Committee examined the instruments which had already arrived, and accepted the majority of those submitted for approval. They formed sub-committees for the purpose of examining the different classes of the instruments and appliances, and agreed that they should meet weekly until the Exhibition should open. It is, therefore, hoped, that all the arrangements will be completed before the 8th of April, so that a clear week for private views and the visits of reporters may be allowed before Easter Monday, when the collection will be thrown open to the public.

Testimonial to Dr. Bence Jones.—At a meeting of the Managers of the Royal Institution, held on Monday, March 10, 1873, specially to consider a letter from Dr. Bence Jones, resigning his office as Honorary Secretary, the following Resolution was unanimously agreed to:—"The Board of Managers receive with deep regret the letter of Dr. Bence Jones containing his resignation of the office of Secretary to the Royal Institution. They lament the reason which compels him to relinquish a post which he has filled for so many years with equal honour to himself and advantage to the Institution. His conviction of the value of original research, and of the special vocation of the Royal Institution to continue diligent in promoting it, was with him an unceasing stimulus to exertion. His attention to every detail left nothing neglected in the performance of his duties. His own scientific attainments have been of signal effect in maintaining respect for the Institution, and in procuring the co-operation of eminent men in the Laboratories and Lecture Theatre. His love of the place and its memories has been shown by the pains he took to collect its early annals,—including in this work an account of the discoveries of Young and Davy,—and by his becoming the historian of Faraday. The Managers cannot fail to remember that the services of Dr. Bence Jones have been given under the pressure of important professional engagements, and latterly, under the additional difficulties of failing health; and that until now, reluctantly compelled to resign, he has never relaxed in the active prosecution of his honourable task. The Managers, however, trust, that the aid of Dr. Bence Jones may not be altogether lost to the Institution; but that he will still afford to it the benefit of his counsels and experience. They hope that he may in future occupy a seat at the Board of Management; and further, that he will remain associated with the Institution, by doing it the favour of accepting the position of Honorary Assistant Secretary. They believe that the distinguished success which has attended Dr. Bence Jones in his career as Secretary will always be his worthiest reward. It rests with them to tender to Dr. Bence Jones the expression of their strong personal regard, and of their warmest gratitude for his invaluable services to the Royal Institution." It having been ascertained that the form of Testimonial most agreeable to Dr. Bence Jones would be a bust of himself to be placed in the Royal Institution, the Managers resolved to open a Subscription List among the Members of the Royal Institution for the purpose. Individual Subscriptions to be limited to £3 3s. as a maximum. Subscriptions to this Testimonial may be paid either at the Royal Institution, or to "The Dr. Bence Jones Testimonial Account," at Messrs. Drummonds, the Bankers, Charing Cross, who are authorised to receive the same.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 3, 1873.

Contains the following original papers and memoirs more particularly relating to chemistry:—

Action of an Electric Current upon a Mixture of Equal Parts by Bulk of Carbonic Acid and Proto-Carburetted Hydrogen (Marsh-Gas).—P. and A. Thenard.—The detailed account of a mode of experimenting, the result of which has been already quoted. The authors state that this communication is only preliminary.

Researches on the Saline Decompositions.—L. Joulin.—This monograph treats on double decomposition, and is divided into the following sections:—Carbonates; salts of manganese; excess of one of the salts; influence of the temperature; other metallic salts; velocity of the reactions; phosphates; borates. As regards the carbonates the following is the result arrived at:—The reaction between carbonates and metallic salts yields (irrespectively the property of the oxides to form or not to form hydrates) mixtures of carbonates and of oxides of the metals, generally in indefinite proportions; and this holds good for all degrees of dilution of the alkaline carbonate, but only for a certain degree of dilution of the metallic salt when in excess. The quantity of oxide increases with the degree of dilution and the temperature. The metallic carbonate is decomposed by the alkaline carbonate which has not yet entered into combination.

Researches on the Occlusion (Dissolution) of Gases in Pig-Iron, Steel, and Wrought-Iron.—L. Troost and P. Hautefeuille.—This paper, the continuation of a memoir on this subject, treats in the first place on the absorption of hydrogen by cast-iron when molten in a scoop made of charcoal, and kept at a very high temperature. The gas is absorbed in rather large quantity, but on cooling it is given off again, giving rise to spirting of the still fluid metal. Carbonic oxide is not perceptibly absorbed. Next an account is given of a series of results of experiments on the gases occluded from cast-iron, soft wrought-iron, and steel; first in their usual condition, and next after saturation of the metals; the gases operated with being hydrogen and carbonic oxide. It appears that the metals also absorb some nitrogen and carbonic acid.

Modifications of the Spectrum of the Chlorophyl under the Influence of Alkalies.—J. Chautard.

Application of Concentrated Ozone as a Reagent upon Organic Substances—Ozobenzine.—A. Houzeau and A. Renard.—After general observations on the action of ozone and of oxidising substances, this memoir treats on the action of ozone upon benzine. Among the products of this reaction the authors call particular attention to ozobenzine, an amorphous, solid, white-coloured substance, which is dangerously explosive — a decigramme being sufficient to cause damage to buildings. The compound is, however, very unstable, becoming converted into a fluid which contains acetic acid. Ozone (that operated with by the authors contained 60 miligrammes to the litre of oxygen) mixed with bicarburetted hydrogen (ethylen, $C_4H_4(C_2H_4)$ gives rise to an instantaneous and violent explosion, accompanied with vivid combustion even at the ordinary temperature, and in the dark (absence of sunlight); but no reaction at all was observed between ozone and hydride of methyl, $C_2H_4C(CH_4)$.

On Anthracenamine.—Dr. T. E. Phipson.—See Chemical News, vol. xxvii., p. 97.

A Derivative from Tetra-Chloride of Naphthaline. — E. Grimaux.—The second instalment of an exhaustive essay on this subject, elucidated with a series of formulæ.

March 10, 1873.

Contains the following original papers and memoirs relating to chemistry:—

Density of the Vapour of Perchloride of Phosphorus.—A. Wurtz.—The contents of this lengthy essay, elucidated by a series of tables exhibiting results of experiments, may be summarised as follows:—The normal vapour-density of perchloride of phosphorus is that of a non-dissociated atomic combination. When two volumes of vapour of the protochloride contain 3 atoms of chlorine to 1 atom of phosphorus, two volumes of vapour of perchloride contain 5 atoms of chlorine for 1 atom of phosphorus. There is no reason to suppose that 2 of these 5 atoms of chlorine should differ from the 3 others. The whole 5 are combined with 1 atom of phosphorus, and the 6 atoms so united form the atomic combination which constitutes the perchloride of phosphorus, while the phosphorus only manifests three atomicity in the protochloride—a non-saturated combination—and also in the phosphuretted hydrogen. The phosphorus exhibits pentatomicity in the perchloride of phosphorus.

Industrial Production of Cold by Aid of the Expansion of Permanent Gases, and more Especially Air.—J. Armengaud.—The detailed description of the process and mechanism by which this object is attained.

Experiments on Putrefaction, Disinfection, and the Preservation of Organic Substances.—M. Laujovrois.—According to the author's researches fuchsine—1-100th part—has the property of acting both as a disinfectant and as an antiseptic; while aniline violet is stated to be even more active in preserving nitrogenous substances.

Assimilability of Phosphates.—H. Joullie.—The action by double decomposition of oxalate of ammonia upon phosphates (native more particularly), and the more or less solubility of the same in acetic acid, is considered by the author to give a clue to their assimilability by plants.

Benzylated Naphthaline.—Ch. Froté.—The author records at length, and elucidates by formulæ, the results of the reactions of chloride of benzyl, naphthaline, and metallic zinc aided by heat. The benzylated naphthaline is a solid, colourless substance, insoluble in water, very soluble in ether, fusion-point 64°, formulæ, $C_{17}H_{11}$.

Combination of Urea and Chlorated Acetyl.—D. Tommassi.—This memoir, elucidated by a large number of complex formulæ, treats on a new compound, chloracetyl-urea, a solid, crystalline, colourless body, insoluble in cold, slightly soluble in hot water, readily soluble in alcohol, partly decomposed, partly sublimed, unaltered at about 160°; simplest formula—

$$\left.\begin{matrix} CO'' \\ (C_2H_2ClO)'H \\ H_2 \end{matrix}\right\} N$$

Memoir on the Composition of the Raw Sugars.—Third Produce (from Beet-Roots) and on the Commercial Analysis of the Same by the Estimation of the Ash they Contain.—Ch. Violette.—The contents of this essay bear more particularly upon the beet-root sugar-making process.

Observations on the Composition of Guanos, on their Alterations, and on the Probable Origin of the Fossil Phosphates of the Lot District (France).—A. Baudrimont.—The most salient point in this paper is the opinion that the phosphatic minerals of the Lot district might have been derived from ancient guano deposits.

Saccharine Matter Contained in Mushrooms.—A. Müntz.—This paper contains, in the first place, a *resumé* of the labours and researches of Braconnot, Mitscherlich, Sacc, and others on the saccharine matter contained in different species of mushrooms: next, the author records his researches, from which it appears that some species of these cryptogams do not contain *Agaricus campestris*, for instance, mannite, nor also trehalose; while again the *A. muscar.*, which is very poisonous, and contains 10 per cent of trehalose only.

This number contains further a large number of papers relating to mathematics, astronomy, meteorology, physiology, natural history sciences, and palæontology. Among the latter attention is called to—

Existence of Man During the Glacial Epoch in Alsace.—Ch. Grad.

La Revue Scientifique de la France et de l'Etranger, March 8, 1873.

Contains no original papers on chemistry.

Bibliography.—"Les Animaux Fossiles du Mont Léberon, Etude sur les Vertébrés Fossiles," par M. A. Gaudry; Paris: Savyéditeur, 1873. A very important addition to palæontology. The locality named is situated in the south of Fraace.

March 15, 1873.

Contains no original papers relating to chemistry, but attention is called to a memoir on—

Propagation of Heat in Crystalline Bodies.—E. Jannetas.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 23, 1873.

Contains no matter relating to chemistry, but attention is called to the following papers:—

Machinery for Sharpening Saws.—M. Baras.—The account of a contrivance by which saws are rapidly and uniformly sharpened.

Improved Pressure-Gauges.—J. Brau.—The improvement mainly consists in an arrangement for illuminating these instruments by a source of light placed in the interior.

Bibliography.—"Les Plantes Etudiées au Microscope," par J. M. Girard; Paris: Hachette et Cie. An excellent book on micro-phyto-histology.

January 30, 1873.

Filter for Water.—M. Henry.—The description of a contrivance useful for the filtration of water for domestic purposes.

Gas Regulator; Pressure Regulator. — J. Maldant.—The account of a mechanism suited for the purpose of so regulating the gas supply to the burners that the combustion is complete; and excess of air as well as of gas avoided, thereby producing a considerable saving in the consumption of the latter.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

538. C. Burfit, New Wimbledon, Surrey, "The manufacture of a new composition for the removal and prevention of incrustation in steam-boilers."—Hetition recorded February 13, 1873.

587. T. Cattell, M.D., Clarendon Square, Middlesex, "Improved methods for purifying gutta-percha."—Petition recorded February 17, 1873.

645. J. Webster, Birmingham, "Improvements in applying gases or vapour to the refining and purifying of metals, and in apparatus to be employed for that purpose."—Petition recorded February 20, 1873.

667. M. Henry, Fleet Street, London, "Improvements in the manufacture of sugar."—A communication from L. A. A. de Savignon, Boulevart Saint-Martin, Paris.—Petition recorded February 21, 1873.

672. F. Deakin, Willenhall, Staffordshire, "Improvements in puddling furnaces used in the manufacture of iron and steel."

680. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphate of soda and sulphate of potassa."

682. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the purification of syrups and sugar."—A communication from L. J. F. Margueritte, Paris.—Petitions recorded February 22, 1873.

695. J. A. Lee, Lydney, Gloucestershire, "Improvements in boiling wood or other fibrous material for the manufacture of paper, and in the treatment of the waste leys."—Petition recorded February 24, 1873.

701. J. Liebert, Kensington Park, Middlesex, "An improved mixture of ground substances to be used as a substitute for coffee, and in the apparatus employed in the preparation thereof."

704. T. Chappell, Finsbury Park, Middlesex, "Improvements in the manufacture of gas."

705. J. Fawcett, Kirton-in-Lindsey, Lincolnshire, "Improvements in the treatment of peat."—Petitions recorded February 25, 1873.

710. E. Metge and F. N. C. Vinbert, Boulogne-sur-Mer, France, "An improved mode or process of preserving meat."—Petition recorded February 26, 1873.

728. A. E. Webb, Stepney, Middlesex, "Improvements in candles and night-lights, and in the treatment of materials therefor."

732. J. G. Redman, New Brompton, Kent, "Improvements in compositions for preventing the corrosion and the fouling of ships' bottoms or other submerged structures."

736. R. Jukes, Sheffield, "Certain improvements in the construction of reverberating furnaces or cupolas, and in the processes connected therewith for the purpose of smelting."—Petitions recorded February 27, 1873.

NOTICES TO PROCEED.

3101. W. R. Lake, Southampton Buildings, London, "Improved processes and apparatus for manufacturing compounds of pyroxyline or gun-cotton."—A communication from J. W. Hyatt and J. S. Hyatt, Albany, New York, U.S.A.—Petition recorded October 21, 1872.

3198. J. Foley, Montreal, Canada, "Improvements in the manufacture of half-stuff and paper."—Petition recorded October 28, 1872.

1. C. W. Harrison, High Holborn, Middlesex, "Improvements in treating certain gases for lighting and heating purposes, and in combining atmospheric air therewith."—Petition recorded January 6, 1873.

505. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of chlorine."—Petition recorded February 11, 1873.

599. C. W. Sutton, Stowmarket, Suffolk, "Improved combinations of ingredients for removing acidity from ales, beers, porters, wines, &c., and also to preserve them from acidity."—Petition recorded February 18, 1873.

PATENTS SEALED.

2648. A. C. Duncan and A. Duncan, Manchester, "Improvements in the production of Turkey-red."—Dated September 6, 1872.

2667. E. Ross, Jeffrey's Square, London, "An improved method of utilising and giving additional value to the products of the coffee-bush."—A communication from R. Dawson, Colombo, Ceylon.—Dated September 9, 1872.

2687. B. B. Standen, Blackheath, Kent, "Improvements in collecting and treating human excrement, both solid and liquid, and in the treatment of other animal urine, also in the means or apparatus employed therein."—Dated September 11, 1872.

2719. W. R. Lake, Southampton Buildings, London, "An improved process and compound for tempering and refining steel."—A communication from W. N. Severance, South Bend, Indiana, U.S.A.—Dated September 13, 1872.

2943. E. J. Payne, Packwood, Warwickshire, and W. Clarke, Dudley, Worcestershire, "Improvements in converting or partially converting iron into steel."—Dated October 25, 1872.

3180. A. Malam, Dumfries, N.B., "Improvements in the manufacture of illuminating-gas, and in apparatus therefor."—Dated October 26, 1872.

3930. B. White and P. T. Hendry, Glasgow, N.B., "Improvements in treating liquids to be burned for illuminating purposes."—A communication from J. Hale, jun., Cincinnati, U.S.A.—Dated December 27, 1872.

3956. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of maize and other like grain for the production of starch therefrom, and in the utilisation of the waste-products for the manufacture of cardboard and paper and for the preparation of soaps."—A communication from E. Leconte, Paris.—Dated December 30, 1872.

14. G. Rawle and W. N. Evans, Bristol, "Improvements in the manufacture of leather."—Dated January 1, 1873.

35. W. B. Stephens, Strand, Westminster, "Improvements in the manufacture of paints."—Dated January 3, 1873.

168. J. L. F. Target, Portsdown Road, Middlesex, "Improvements in treating excreta and sewage matters, and in apparatus employed therein, parts of the apparatus being also applicable to the drying and charring of other matters."—Dated January 15, 1873.

216. L. Stevens, Washington, U.S.A., "A process for forming carbonic oxide from oxyhydrogen vapour or steam, and an apparatus for utilising the same for heating purposes."—Dated January 18, 1873.

NOTES AND QUERIES.

Ponceau.—In the CHEMICAL NEWS, vol. xxvii., p. 20, ponceau made from carbolic acid is mentioned. Do any of your readers know where we can find a description of this ponceau, and its mode of manufacture.—S. and H.

Bunsen's Burner.—Can you tell me if there is any mathematical formula for increasing the size of Bunsen's burner. I want a large one, say two inches diameter, to burn with a steady flame. I can succeed very well with a tube half an inch diameter, and five inches long, but that is too small.—E. R.

Ammonium Sulphate.—Can you, through your valuable paper, or otherwise, inform me how ammonium sulphate in concentrated solution is usually concentrated so as to "fish" out the anhydrous salt. Are lead or iron vessels used, or lead supported by iron; and is a steam or fire heat used? My steam won't do it applied at two and a half atmospheres. It seems to me as if it would soon destroy a jacketted *wrought* iron pan, as it becomes strongly acid when boiled long. The quantity I have to operate upon is large, say 1000 gals. at a time. I have consulted your Wagner's "Technology," and Richardson and Watts without finding what I want. Any information will oblige.—W. B. GILES.

On Approach Caused by Vibration.—Dr. F. Guthrie, in a paper read before the Royal Society, December 17th, 1868, says:—"There is, perhaps, nothing essentially contrary to reason in the conception of two bodies in space free to move so related to one another that, while the first has no tendency to move towards the second, the second has a tendency to move towards the first. But if the tendency of the one to move be caused by the condition of the medium between the two, it seems inevitable that the tendency shall be mutual. Thus, if that tendency result from a general diminution in the tension of an elastic medium between the two, they will be urged towards one another." . . . . "We have here, accordingly, an experimental proof that the rapid motion (in this instance vibration) of a body in a medium produces, on the whole, an effect similar to that which would be produced by the expansion of the body, viz., a displacement of the medium." . . . . "Whenever an elastic medium is between two vibrating bodies, or between a vibrating body and one at rest, and when the vibrations are dispersed in consequence of their impact on one or both of the bodies, the bodies will be urged together. . . . The line of conclusion here indicated tends to argue that there is no such thing as attraction in the sense of a pulling force, and that two utterly isolated bodies cannot influence one another." . . . . "If the ætherial vibrations which are supposed to constitute radiant heat resemble the aërial vibrations which constitute radiant sound, the heat which all bodies possess, and which they are all supposed to radiate in exchange, will cause all bodies to be urged towards one another."

MEETINGS FOR THE WEEK.

MONDAY, March 24th.—Medical, 8.
—— Royal Geographical, 8½.
London Institution, 4.
TUESDAY, 25th.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 26th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 27th.—Royal, 8½.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
—— Philosophical Club, 6.
FRIDAY, 28th.—Royal Institution, 9. Prof. W. K. Clifford, "On the Meaning of Force and Energy."
—— Quekett Microscopical Club, 8.
SATURDAY, 29th.—Royal Institution, 3. Prof. Max Muller, LL.D., "On Darwin's Philosophy of Language."

TO CORRESPONDENTS.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 696.

ON SUPERSATURATED SALINE SOLUTIONS.*

By CHARLES TOMLINSON, F.R.S.

This subject, which has been discussed during nearly three-quarters of a century, and has occupied many subtle minds, cannot be said to be at present in a settled condition. Some observers, even at the present day, imagine that any one of these solutions is a liquid in a state of unstable equilibrium ready, on slight provocation, to pass into the solid form. A recent writer remarks that these solutions can be preserved a long time, provided the vessels containing them be kept quite still. One observer found that on introducing a knitting-needle into the solution it produced crystallisation, but when passed through the cork which closed the flask it had no such effect. In cases of this kind the distinction, first pointed out by Mr. Tomlinson, between chemically clean and unclean surfaces, or, as he calls them, *catharised* and *uncatharised*, clears away a host of anomalous cases, and reduces the problem to the simple question—"What is a nucleus?" He has shown that bodies by exposure to the air, or to the touch, become more or less covered with films foreign to their composition, and which make them unclean, so that, if introduced into a supersaturated gaseous, vapourous, or saline solution, they liberate gas or vapour, or determine crystallisation. So, also, an oil or other body, deposited on the surface of the solution so as to form a film, determines crystallisation; whereas, if such body retain the lenticular or globular form, it does not induce crystallisation, since it is separated from the solution by surface-tension.

On the other hand, it is maintained by several observers, among whom we may distinguish M. Gernez and M. Violette, (1) that the only nucleus capable of suddenly crystallising any one of such solutions is a salt of the same kind as that dissolved; and (2) that all bodies, solid, liquid, or aëriform, which apparently act as nuclei, are really contaminated with a hydrate of the salt that forms the supersaturated solution.

In dealing with supersaturated solutions, we may take that of sodic sulphate as a type. It will be remembered that this salt exists in three forms—(1) The ordinary salt, containing ten equivalents of water of crystallisation. By exposing this salt to the air it passes rapidly into (2) the effloresced or anhydrous salt. There is (3) a seven-hydrated salt formed in supersaturated solutions, in close vessels, on a suitable reduction of temperature.

Now everyone admits that of these three varieties the ten-atom hydrate is the only one that acts as a nucleus on a supersaturated solution of Glauber's salt, and that the seven-atom hydrate and the anhydrous salt have no action whatever as nuclei.

Of course, if it can be shown that an oil or other body does, under certain conditions, induce the crystallisation of a supersaturated solution of Glauber's salt, the theory, that a crystal of the ten-atom hydrate of sodic sulphate is the only nucleus, falls to the ground.

Without reiterating former experiments, about which there is so much controversy, Mr. Tomlinson falls back upon a statement made by him in his second paper, published in the *Philosophical Transactions* for 1871, to the effect that, if a drop of oil deposited on the surface of a supersaturated solution of Glauber's salt form a lens, there is no separation of salt, even though the flask be turned round rapidly so as to disperse the oil in small globules through the solution. But, "if while the flask is being turned round, a sudden jerk be given to it, so as to flatten some of the globules against the side into films, the whole solution instantly becomes solid."

In a note read before the Royal Society on the 13th inst., the following experiment was described:—

A solution of sodic sulphate (1 part of salt and 1 part of water) was filtered into a pear-shaped flask nearly 12 inches in height; a small beaker was put over the opening in the neck, and the solution boiled. Next day the flask was taken into the open air, oil of sweet almonds was dropped into it, and the cork inserted. After about an hour the flask was whirled round, so as to disperse the oil into minute globules through the solution, giving it the appearance of an emulsion. The flask was left at rest during about an hour, then suddenly shaken, so as to rattle the solution against the side, when all at once, as if with a flash, it became solid.

Now in this case it may be objected that a crystal of the sodic sulphate hydrate was derived from one of the following sources:—(1) From the air, (2) from the oil, (3) from the cork, or (4) from the side of the flask. (1). It could not be derived from the air, either of the laboratory or of the open air, because the solution remained liquid long after the flask had been corked. (2). It could not have been derived from the oil, because this was dispersed through the solution in myriads of globules without any nuclear action, and the flask was left to repose for an hour after the oil had been so dispersed. (3). Nor could any nucleus have been derived from the cork, because the solution never touched it. Nor could a minute speck of the sodic sulphate hydrate have fallen from the cork, for the latter had been put into hot water, out of which it was taken the moment it was put into the flask. It could not have been derived from any of the hot water from the cork streaming down the side of the flask to the solution, (1) because sodic sulphate in solution is in the non-nuclear anhydrous state, and (2) because two hours had elapsed between the corking of the flask and the solidification of the solution. (4). A crystal could not have been derived from the walls of the flask, because the solution had been briskly boiled in it, so that steam escaped with considerable force from the neck after the small beaker had been put on. Hence, on the principle of exhaustion, Mr. Tomlinson is compelled to fall back on his former statement—namely, that the oil acted as a nucleus by the flattening of one or more of the globules against the wall of the flask into the form of films.

A number of experiments were tried with solutions of various strengths—such as 2 salt to 1 water, 3 salt to 1 water, 3 salt to $1\frac{1}{2}$ water; and also with other salts, such as potash-alum and ammonia-alum; and with various oils, volatile and fixed—the object being to show that some supersaturated saline solutions really do crystallise under the action of other nuclei than a salt of the same kind as the solution operated on.

All the experiments were conducted in the open air, although they were much impeded by the rainy weather of last year. There is, however, this advantage in wet weather, that the saline particles said to exist in the air are washed down and brought into solution, in which condition they are not nuclear, as has been shown in the case of sodic sulphate, alum, and one or two other salts.* On the other hand, fine weather has its advantages; not only are the surfaces of the solutions more active, and the evaporative force stronger, but hydrated salts, said to exist in the air, part with their water of crystallisation so readily as to reduce them to the non-nuclear condition, while the minute particles of the salt, said to give force to the dust floating in a room, could not exist in the hydrated form for an hour. This is especially the case with sodic sulphate. It had been already shown that supersaturated solutions of this salt may be exposed to the air, both in fine and wet weather, for a long time without crystallising,† as well as the the fact just noticed,‡

* Abstract of a paper read before the Royal Society.

* Chemical News, February 4, 1870, p. 52.

† *Proc. Roy. Soc.*, 1871, p. 41.

‡ Chemical News, February 4, 1870, p. 52.

that a solution of a salt does not act as a nucleus to its supersaturated solution.

Seeing, then, that in the case of sodic sulphate, which is said to be always present in the air of rooms, and, according to MM. Gernez and Violette, even in that of the country, the chances are that it is most likely to be present either in the effloresced condition or in solution, and equally non-nuclear in both, Mr. Tomlinson thinks that too much importance has been given to this part of the subject; for, if it be true, we are reduced to the dilemma, pointed out by M. Jeannel,* that there must be floating in the air specimens of all kinds of salts that form supersaturated solutions and crystallise by the introduction of a solid nucleus; whereas, there are some such salts which cannot exist in the presence of the oxygen or of the ammonia of the air.

INFLUENCE OF CHANGES IN BAROMETRIC PRESSURE ON ANIMAL LIFE.

We propose to follow the progress of M. P. Bert's researches on this subject, as recently described to the Paris Academy of Sciences.

In the series of experiments, of which an outline has already been given in the Chemical News (vol. xxvi., pp. 38 and 136), the principal points taken up by M. Bert have been these;—Effects of diminished pressure, with special reference to composition of enclosed air after death of the animal; effects of increase of pressure similarly; effects of super-oxygenated air at increased and at diminished pressures; quantities and proportions of gases in the blood of animals subjected to diminished pressure of ordinary air; the same in case of increased pressure; effects of decompression, gradual and sudden.

One of the most singular facts met with in these researches was the undoubtedly toxical action of oxygen in air sufficiently compressed. To this phenomenon M. Bert has given further attention.

In sparrows this action is shown by strong convulsions, when the exterior pressure of oxygen may be represented by 350 (the pressure of pure oxygen at 1 atmosphere being taken as 100), which may be obtained either by using pure oxygen at $3\frac{1}{2}$ atmospheres ($100 \times 3 \cdot 5 = 350$), or ordinary air at about 17 atmospheres ($17 \times 20 \cdot 9 = 355$). These convulsions are very violent, and quickly fatal when the pressure of oxygen reaches 450 (corresponding to 22 atmospheres of air). They appear in about 4 or 5 minutes; the bird shakes its head and feet as if it were on burning coals; presently it opens out its wings, which flutter violently; then falling on its back, it turns about quickly in the receiver, continuing to beat the air with its wings, and its feet being drawn in. These movements continue a few minutes, then are stilled; reappearing, however, and repeatedly, in crises, which become more frequent and less violent, till death or release. They may, however, continue after the air has been restored to normal pressure.

With dogs, also, M. Bert found convulsions appear when the external pressure of oxygen was about 350, while death took place at a pressure of about 500. As he had not sufficient oxygen to charge his receiver (of 400 litres' capacity) to 5 or 6 atmospheres, he took the plan of fixing in the trachea of a dog a pipe connected with a caoutchouc pouch which contained oxygen, and subjected pouch and animal to pressure at the same time. Extracting arterial blood, and determining the proportions of gases in it (in a way previously described), he found the convulsions appear when this blood, which ordinarily contains 18 to 20 c.c. of oxygen per 100 centimetres of liquid, came to contain 28 to 30 c.c., in consequence of pressure. Death took place at about 35 c.c. It thus appears that the toxically fatal proportion of oxygen in the blood is less than double the normal quantity. There is no other poison of which we could, with impunity, have in the blood half of the dose which would prove fatal.

M. Bert describes the phenomena presented by a dog in which the proportion of oxygen in the arterial blood has attained 32 c.c. per cent. When taken from the aparatus the animal is generally in full tonic convulsions; the paws are rigid; the body is curved backwards or a little to one side; the eyes are protruded, the pupils dilated, the jaws closely shut. There are, as in the case of sparrows, relaxations and recurring crises; in the latter, respiration is suspended, but the heart continues to beat, though often very slowly; sensibility remains. The convulsions become less violent; the rigidity diminishes, and finally disappears at the end of five, ten, or even sometimes twenty hours.

In the lighter cases, there are disorderly movements and local convulsions, the phenomena generally resembling those produced by phenic acid. In the more severe, on the other hand, as when the proportion of oxygen reaches 35 c.c., the rigidity is more continued, with occasional clonic spasms; the teeth are ground together, and death appears after one or two crises, in a few minutes. The arterial blood is dark, as in asphyxia; the heart continues to beat some minutes after the animal has ceased to show any other movement.

As to the mechanism of the poisoning, M. Bert infers from his experiments that the toxical action produces its effect on the nervous centres like strychnine, phenic acid, and other such convulsive poisons. This presumption is corroborated by the fact that the inhalation of chloroform momentarily arrests the convulsions, which reappear when the anæsthesia has ceased. A posterior limb, the sciatic nerve of which has been cut, shows no convulsions in the muscles connected with this nerve.

It is a striking fact, that the convulsions often continue after the blood, through free respiration, contains no more than its normal quantity of oxygen. May it happen that, under the influence of oxygen, there is formed in the blood a toxical matter capable of altering the functions of the anatomical nervous elements? M. Bert thinks not; he injected into the veins of a healthy dog some blood taken from an animal in full convulsions produced by oxygen, and no toxical effect was observed. The blood corpuscles, moreover, show no particular alteration in form or dimensions.

The temperature of the animals fell two or three degrees when the convulsive action commenced, and rose again at the end of a few hours if the animal survived. The increased oxygen is not, then (as might be thought), the occasion of more energetic combustion; on the contrary, the internal combustion seems to be diminished. This apparently paradoxical conclusion M. Bert proposes further to investigate.

The results of this enquiry, then, are briefly these:—Oxygen, a powerful poison when its proportion in the arterial blood reaches about 35 c.c. per 100 c.c. of the liquid; the poisoning characterised by various convulsions, which are due to increased excito-motor power of the spinal cord; and the process attended by diminution of internal temperature.

In studying the dangerous and fatal effects of sudden decompression, M. Bert had attributed them to the return of nitrogen, dissolved in excess in the blood, to the free state. The gas-bubbles may only intercept the circulation in particular parts, and especially in the lumbar region of the spinal cord, whence ensues paraplegia, &c.; but they may appear in sufficient quantity to obstruct the lungs, inflate and arrest the heart, and cause speedy death.

Now, it appears that the danger is very various for different species and different individuals. Thus for sparrows, death (from sudden decompression) appears only when the pressure has reached 11 atmospheres; for rabbits and cats, the limit is about 9 atmospheres; for dogs, it oscillates between 7 and 8. It would seem that the danger increases with the animal's size; and we know

* *Ann. d. Chem. et de Phys.*, 4th ser., vol. vi., p. 166.

that in the case of man there are fatal accidents at 5 atmospheres.

Applying himself to these curious inequalities, M. Bert ascertained, first of all, that the arterial blood of a dog which breathes air at normal pressure is nearly saturated with nitrogen at the same pressure. He watched the blood in dogs submitted to increasing pressures, and saw gas-bubbles first appear at about 3 atmospheres. But the injurious effects did not appear till about 7 atmospheres. There is, then, between 3 and 7 atmospheres, a period in which the blood of decompressed dogs may contain free gases, without the animals appearing to suffer. This is doubtless because the bubbles are so fine that they can pass through the capillaries without causing obstruction. Still it is to be remembered that there is danger in this period, and certain accidents may occur even in decompression from low pressures. This is evident from the fact that some divers, *e. g.*, are paralysed, and sometimes killed, through decompression, which produces no injury to others. In the period referred to the bubbles have only to collect in a particular manner, under secondary causes, in order to cause serious accident.

As M. Bert was pursuing his inquiries, an accident occurred to interrupt his work, but which, at the same time, brought to light a fresh fact connected with the subject.

He had been keeping a dog under a pressure of 9½ atmospheres for about an hour, when one of the glass plates in the side of the chamber broke with a loud explosion, and the apparatus was torn from its supports by the violent recoil. The animal, of course, was instantly killed, and its blood-vessels were found, as usual, to be filled with gas; but for the first time M. Bert found gases in the ventral cavity, with a general emphysema of the subcutaneous and intra-muscular cellular tissue. Thus it appears that the liberated gases may accumulate not merely in the blood, but in the other juices of the system. The reason they were not here met with before was, probably, that the decompression had not been sufficiently sudden, or that the animals had not remained long enough under pressure. The itching and muscular swellings often experienced by workmen in tubes may probably be connected with a fine gaseous infiltration of the cellular tissue.

How are accidents through decompression to be prevented? Obviously (it is replied) by a prudent and measured decompression. When a pressure of 9 or 10 atmospheres has been reached, it is necessary the decompression should not be faster than 12 minutes per atmosphere. It sometimes appeared advantageous not to decompress regularly, but to proceed by sudden falls of 1 to 2 atmospheres, allowing the animal a certain time of equilibrium after each fall.

When injury has been done, when paralysis *e.g.* has commenced, when death is imminent, is it possible to remove the danger, and how? The first idea which occurred was to recompress the animal, in order to re-dissolve the liberated gas; it would then be sufficient to decompress more prudently. M. Bert's apparatus, however, did not permit of his effecting this. An hour was consumed in increasing the pressure to 10 atmospheres, and the animal was by that time dead. He thinks, however, the method may be employed in the case of divers, who should immediately be sent down into the water again.

How is death in the above cases produced? The bubbles of nitrogen accumulate in the right side of the heart and in the pulmonary arteries. They remain there; without becoming dissolved, because the blood is saturated with nitrogen; without being diffused, because the air of the alveoli contains four-fifths of nitrogen. M. Bert hoped, however, by making the animal respire a gas not containing nitrogen, that the diffusion would proceed quickly enough to allow of a renewal of the pulmonary circulation, and so, of the animal being relieved. In this he succeeded. He made dogs which were completely paralysed, whose hearts gave a gurgling sound, and whose jugular veins, laid bare, appeared inflated by the gas, breathe oxygen nearly pure: the gas-bubbles in the jugular rapidly disappeared, the sounds of the heart became normal, and the respiration regular.

In some cases, however, paraplegia or paralysis continued several hours, and the autopsy explained this. In the general circulatory system the liberated gas had disappeared, but in the nervous centres there were small vessels filled with gas-bubbles, so that the local circulation in these important organs was arrested.

From the foregoing results M. Bert finds himself in a position to advise engineers and others, who employ divers and workmen exposed to the dangers in question, to make their men respire oxygen after decompression, where this is apt to be dangerous. They might afterwards try recompression; but the respiration of oxygen forms a remedy at once simple, inexpensive, easy of application, and perfectly harmless.

A. B. M.

ON THE

INORGANIC CONSTITUENTS OF SOUND AND DISEASED POTATOES.*

By J. B. HANNAY, F.C.S.

As great discrepancy of opinion exists as to the cause of the potato disease, I thought it might be of some interest to carefully analyse an average sample of both good and bad roots from the same field, especially as some chemists say that a deficiency of potash, and some that an excess, is the cause of the disease.

I obtained three samples—the first consisting of good potatoes grown on well-drained, dark-coloured, mossy soil; the second from the same field were very much diseased, and quite unfit, not only for human food, but were even rejected for cattle-feeding purposes; the third sample was from a field which was badly drained and of a heavy clayey nature. The three samples had received the same manure. The whole of the third sample was diseased, but of an intermediate degree; they could mostly be used for human food, but there was not one which was not in some degree diseased. The following are the results of the analyses:—Sample No. 1, when cut in slices and dried, left 3·8 per cent of ash, No. 2 left 3·9 per cent, whereas No. 3 left 5·1 per cent.

	No. 1.	No. 2.	No. 3.
Soluble portion—			
Potassium	36·77	37·86	43·11
Sodium	3·24	3·12	0·68
Magnesium	1·87	0·00	0·04
Carbon dioxide	15·83	15·57	15·45
Phosphoric oxide	8·37	6·90	5·55
Sulphuric oxide	4·95	5·44	6·28
Chlorine	4·61	6·96	7·37
Insoluble portion—			
Silica	1·74	6·12	1·02
Ferric oxide and alumina	0·62	0·89	1·17
Calcium	3·70	2·80	2·92
Magnesium	0·88	0·60	0·02
Carbon dioxide	2·90	1·45	1·34
Phosphoric oxide	3·70	3·06	6·20
Unburnt carbon	1·98	0·00	0·00
Oxygen, equivalent to metals *minus* equivalent proportion of chlorine	9·64	9·03	9·23
	100·80	99·80	100·38

From these analyses it will be seen that the amount of potassium chlorine and sulphuric acid increase in the diseased root, whereas the soluble phosphoric acid decreases.

* A paper read before the Chemical Section of the Glasgow Philosophical Society.

I noticed on burning the potatoes that in good roots it was very difficult to oxidise all the carbon, in fact the ash obtained was always of a very dark gray colour. In diseased potatoes, however, it is comparatively easy to burn all the carbon, leaving the ash of a greyish white colour. This seems to show that in good potatoes the mineral constituents are more intimately combined with the carbon compounds than in diseased roots, or, in other words, that the disease seems to be a constitutional decay. There is a great deal of evidence in support of this view, and, moreover, most of the practical farmers with whom I have conferred on this subject are of opinion that it is similar in nature to fever or any infectious disease which infect animals. They have found that fields of potatoes growing perfectly healthy have, in the course of a single day, been infected with disease by a mere change of wind, and almost invariably when that change is to the east; even a hot sultry day will sometimes bring on the disease. It always appears on the leaves first, and the roots sometimes show no signs of disease for three weeks after the leaves are infected. On examining a number of specimens by the microscope, I find that on the appearance of disease the starch granules gradually diminish in size and number till, in the very badly diseased parts, only a confused mass of fibre remains. In the good potatoes the starch granules were very full and well developed, whereas in the diseased roots they were very small and meagre. This also points to a constitutional decay.

Most farmers tell me that potatoes grown in dark mossy soil are much less liable to disease than those grown in a clay soil, and, even when the mossy soil is wet and not drained, the roots grown there are almost invariably better than in a clay soil. This seems to show that the average temperature of the soil in which the roots grow has a good deal to do with the health of the plant, as it has been found that the darker the colour of the soil the higher is the average annual temperature.

It may be worthy of remark that some farmers strongly recommend the use of soot as a prevention of disease; and, as the chief property of soot is to absorb all the sun's radiant heat, while it is the only substance which diffuses or reflects none, this affords a further argument in support of the idea that heat applied to the root strengthens the plant. The disease seems to be to the potato what fever or cholera is to man, and is caused by the same conditions —namely, an east wind and sultry weather. The difference in the mineral constituents seems to have little connection with the disease, but there can be little doubt that proper manure and good soil may strengthen a plant, so that, when the withering winds do come, it will be able to withstand the attack of disease. The mineral constituents seem to vary with the soil and locality; in fact, one farmer, who had a field running down to the sea-shore, informed me that the potatoes close to the shore had a large proportion of their potash replaced by soda. On the whole, I think the potato disease is a problem for the naturalist or the physiologist rather than the chemist.

NEW THEORY OF GALVANISM.*

This is a remarkable book. In proof we quote some short sentences from the preface:—"In this perhaps presumptuous effort heat is viewed in entirely novel aspects. Heat is considered no longer exclusively a thing of thermometers and pyrometers, but as a great power in chemistry."

We were certainly of opinion that this had been acknowledged long ago—ever since the science of chemistry existed. Again,—"Heat is considered to be as closely kin to electricity as is infancy to manhood, and thus to be all-worthy of scientific apotheosis." Heat and electricity are generally considered to be merely modifications of force, and as such mutually convertible. The author, if we do not misunderstand him, views them as substantive entities. He informs us that "the most prominent heat-states of chemicals" are their "conditional heat, their specific heat, their weight-heat, and their conduction of heat." The "conditional heat," or "heatfulness," is that in virtue of whose varying degree hydrogen is an unliquefied gas, mercury a liquid metal, potassium an easily fusible metal, and platinum a well-nigh infusible solid. Hydrogen is, therefore, pronounced more "thermic" or heatful than platinum. Specific heat is defined in the usual manner. "Weight-heat, mass-heat, or grain-heat" is that which influences specific gravity, it being assumed "as axiomatic that the lighter a metal the better grained it is."

The allotropic forms of bodies, their "heat shapes," or "glow shapes," are due to different amounts of chemical heat. "To mixture and allotropy of ingredients we owe every chemical compound; mixture brought about by mutual mechanical attraction of the molecules of the combining substances; allotropy produced by the conditional heat-discharges, by loss or gain of heat of the said molecules."

We are again told that in "compounds where there is more mixture than allotropy of ingredients, as in alloys, the resulting compounds are like their parent metals." The generalisation is then suggested that the more violent the reaction which ensues on the contact of the elementary bodies, the more the resulting compound will be unlike either of them. "Heat of transformation, or morphigenic heat" is the great producer of changes. Metals very thermic, as potassium, are never found uncombined. Platinum, eminently athermic, is rarely found combined, and "has the strongest inclination to attract heat, as seen in Dobereiner's lamp." "By the test of weight the metals are, as a class, colder-grained than the metal-attracting metalloids; the metals are *minus* as to heat, and the metalloids *plus* as to heat."

The group of "metal-repellant metalloids"—carbon, silica, and borax—are "conditionally cold;" carbon being the coldest element known, as it has never been fused. Acids are thermic, bases athermic.

Heat influences solubility, so that a "soluble substance is more thermic conditionally than an insoluble one." The following remark is not without interest:—"It may be noted that the colours red and green, given by acids and alkalies to certain vegetable colours, are the acid red colour, the hot colour of the solar spectrum, and the alkali green colour, the cold colour of the solar spectrum." How about the aniline colours when these changes are nearly reversed? The elements are divided into three classes—"Those that have great chemical might, or power, or craft, or better still, shapecraft, such as the four organogens; those that have great chemical activity, such as potassium, sodium, &c.; and the elements that are truly negative, having neither shapecraft nor activity, such as platinum and gold."

The author's examination of the galvanic battery leads him to the conclusion that "ordinary heat, morphigenic heat, and electricity are phases of the same radicle principle." It becomes electricity by concentration.

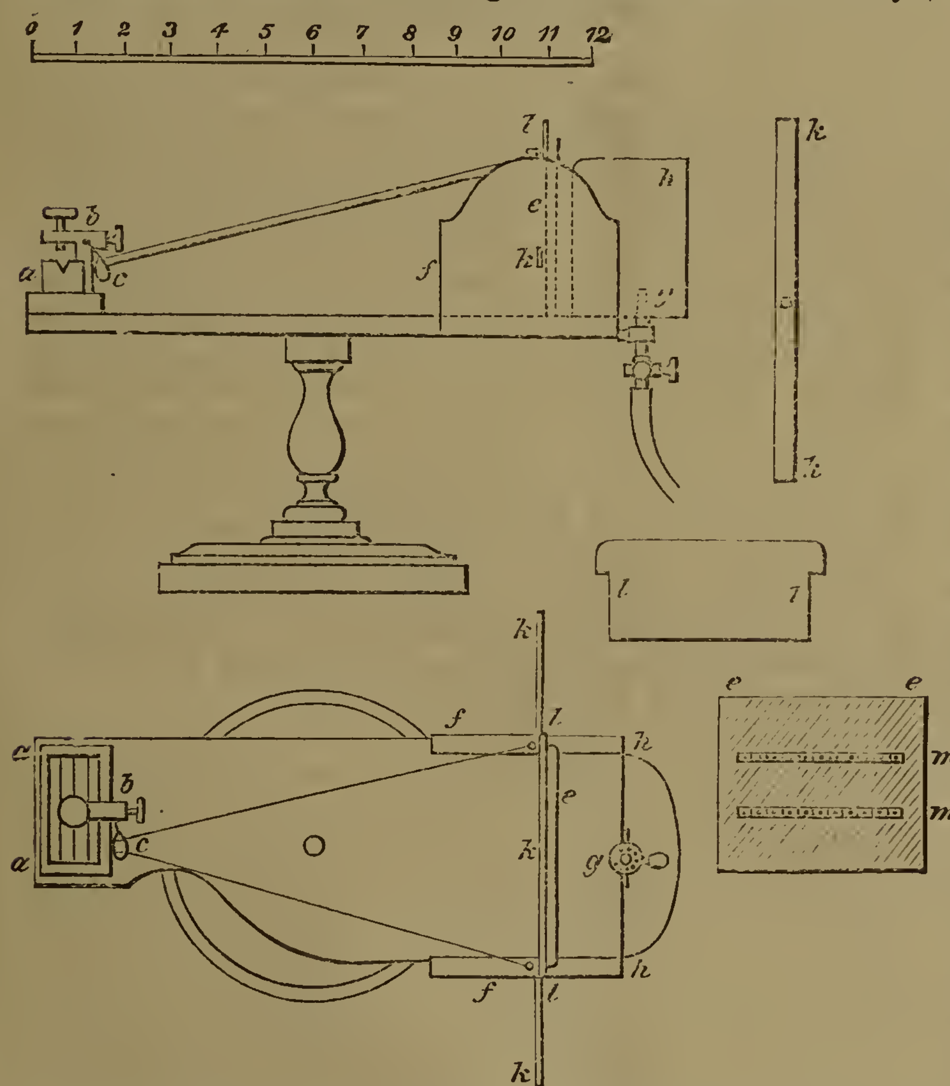
We have thus, as far as space would permit, endeavoured to give our readers some idea of the line of speculation followed in this decidedly original work. That many of the views put forward are questionable will be seen by every chemist. But instead of entering upon a lengthy verbal discussion, we prefer to remind the author of the fine dictum of Dumas:—"Theories are like crutches; to know their worth we must try to walk with them." If Dr. Hall can by means of his hypotheses succeed in bringing facts hitherto isolated into co-ordination—if he can point the road to phenomena as yet undetected, he will succeed in legitimatising his system. Meanwhile, we consider the book decidedly suggestive, and recommend it to the thoughtful perusal of chemists.

* "New Theory of Galvanism; the Electro-Thermology of Chemistry; Electricity and Heat Phases of the same Principle." By T. W. Hall, M.D., &c. Edinburgh: Edmonston and Douglas.

GLASS READING-SCALE FOR DIRECT VISION SPECTROSCOPES.*

By H. R. PROCTER.

Mahogany frame, of ½-in. planed boards, for holding Browning's direct vision pocket spectroscope and reading-scale. *a a*, wood block with V-groove for holding the spectroscope; *b b*, brass clamp and screws for fixing it in its position, and for holding the wire ring, *c c*, to stretch the wire supports, *d d*, of a black curtain for keeping out stray light from the side-hole of the spectroscope; *e e*, photographed glass millimetre, or other scale of equal parts, sliding between two upright mahogany cheeks, *f f*, and lighted from behind by the gas-jet, *g g*; *h h*, a tin screen to shade the flame; *e e*, the dark-glass scale with transparent graduations at *m m*, seen in the spectroscope above and below the spectrum; the upper one can be shut off by a black card screen, *l l*, slipped down in front of the glass plate; and all but three scale-divisions of the lower one, at any point, can be stopped out by a card slider, *k k*, slipping through slits in the two side-cheeks of the frame, to confine the vision to the graduations closest to any



line. The glass plate is backed behind by a piece of oiled paper gummed by its edges to the photographic plate.

Mr. Procter apologised for bringing such a rough affair before the meeting; it was a purely experimental apparatus, but all he could say was that it had answered the purpose well, and he had not had time to get a better one made. No doubt every one who had used the small spectroscope had felt the want of some measuring apparatus, and he supposed that most members would know the construction of the instrument. It contained a compound prism, of which the end formed an angle of nearly 45 degrees with the axis of the tube. Consequently, by drilling a small hole in the tube opposite the face of the prism, you could see a scale set at right angles to it at the same time as by reflection you saw the spectrum. That was the whole principle of this apparatus. A small scale of any description, say of millimetres photographed upon glass, was set up on one side of the spectroscope and lighted by a gas jet. He might say he had found it a great assistance sometimes to cover all the scale, except the few lines which were required at the time, by a piece of card-board with a small slit in it. By sliding this through a hole in the instrument it covered the whole of the scale except two or three divisions, and by that means the dazzling effect of the remainder of the scale upon the eye was entirely avoided. By sliding it along, the centre of the slit was made to coincide with the line it was wished to measure, while the upper part of the scale was covered by a piece of card. Then by removing the card so as to see the upper part of the scale, it was instantly determined what the division was; and he thought that would be found a great practical advantage where the lines were faint. He had used the same measuring arrangement simply by putting the spectroscope in a retort stand-clamp, with this small hole pointing downwards to any sort of scale upon the table; even a foot rule lying on a piece of black velvet answered tolerably well. If the spectroscope was always set at a uniform number of scale divisions distant from the scale, the divisions would remain of the same value whatever their absolute size; and the only thing necessary to make comparative measurements at different times was to bring some one line always upon the same division, and the others perfectly corresponded. He thought it exceedingly probable that a much superior arrangement, so far as the details were concerned, could easily be made. A little care was necessary to get the spectroscope in the right position so as to make the lines come upon the scale. Mr. Browning had written to him to say that he would be very glad to pierce the spectroscopes for the purpose, without any additional charge.

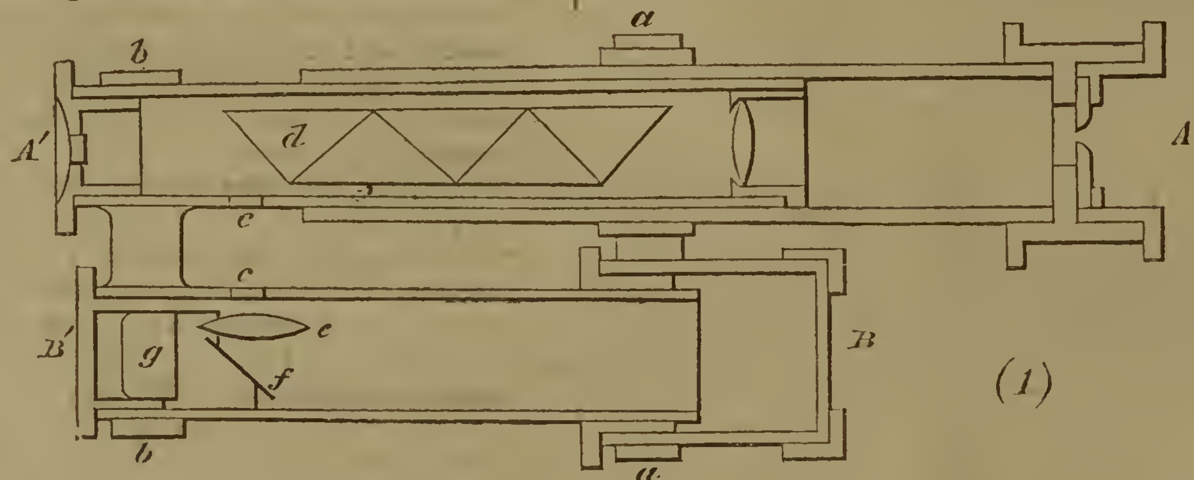
After the reading of this paper, Prof. Herschel said the plan of throwing the scale into the side of the spectroscope was one which had struck him frequently during its use, as necessary for making it practically available. As a test of the identity of any substance which was studied through the spectroscope, some sort of scale is required with Browning's, as well as with every form of small pocket spectroscope. He found it practically, himself, in two or three cases recently. He was in the Elswick Works the other day, looking at the flame coming out from the blast, while stoking and taking the slag from the blast-furnace, and he saw a very brilliant red line. He was at a loss to name and identify that red line; he thought at first it was potash, but it was too sharp, indeed perfectly so. He was then persuaded from its character that it was lithium, but he was not then aware what the lithium could arise from. He asked the manager, who said a Greek ore was being used in the furnace, and that the red line might possibly be copper. He (Prof. Herschel) knew that copper gave a red line, and he put it down as copper as the result of the casual examination with the spectroscope. He was at Birtley Iron Works the other day, and the melting-furnace to melt the iron was blown with coke and a blast; and where the flame escaped it again presented that red line along with the soda—the two lines, yellow and red, which the members had seen that night in the demonstrations of Mr. Procter; but by this time he had made a provision in his spectroscope to make clear what this red line was, and he would be very glad to point out to them the character of that provision used in the spectroscope upon the table; and he was able then to identify the position of this red line after coming home, and to make clear that it was lithium. In most of these blast-furnaces lithium was most distinctly visible. He had only lately read, in books on spectroscopy, that in all gas-carbon and gas-coke lithium is always present, and is easily detected by the spectroscope in their flames; so that, although in the first of his experiments on the furnace-flame he was unable to use Browning's spectroscope as a means of analysis for which it is commonly found to be practically useful, yet, by adding to it a slide of a peculiar kind, he was able afterwards to make sure of the fact that there was lithium in the flame. He congratulated Mr. Procter

* Read before the Newcastle Chemical Society.

on his success in making this little Browning's spectroscope a really practically useful instrument; but while his adaptation and fixing of the scale to it, by which the position of the lines could be measured in the instrument, had done much, no one could carry this about with him, and it was therefore not a pocket scale. The small addition which he (Prof. Herschel) had made to that pocket spectroscope was to put a little film, the thinnest he possibly could, of mica on the glass plate which fitted the eye, and he held it in place with a small india-rubber ring. That film of mica, by inequalities of its thickness, or other refracting properties which it possesses, eclipses certain rays of particular refrangibility, and, according to the thickness, it will eclipse more or fewer bands in the whole range of the spectroscope; so that, looking through it, you get the spectroscope divided into compartments by dark bands. He found four lying between the yellow sodium line and the red one seen in the blast at Birtley; and after coming home, he found the same in looking at a flame of lithium and sodium together. The dark bands are, however, not easily observed. He did not say that his scale was a good one, but it was a pocket one, and it differed in that respect from Mr. Procter's. Then, as the bands are not easily seen, he thought he would bore a hole in the side of the spectroscope, and get a scale reflected in its prisms; and if this scale was to be a pocket one, he must, in this hole, which was bored through, put a small lens, and fix the scale close in front of that lens, for use as a scale of reference. In this form it would have been a miniature of what Mr. Procter had devised; but he could not say he had gone so far as Mr. Procter had to work out a practical result. It would certainly scarcely even in that form be convenient to fold up and carry about; but in the present form, in which it is arranged as a table spectroscope, it has certain very valuable advantages. The use of a spectroscope resolves itself into placing every line according to its scale position on any arbitrary scale, but as far as possible on the scale of what is called the natural standard scale of wave-lengths. If the position of every line which is mapped can be given in wavelength, its description is then intelligible to everybody. The scale fitted to this spectroscope, of uniform intervals, would enable spectra to be recognised; but being a new instrument its indications first require to be reduced to some well-known standard. The simplest way of recording them would be by wave-lengths. The positions of successive lines, as seen in the common spectroscope, are not in the simple proportions of their wave-lengths; the blue lines are more spread out than corresponds to the differences of their wave-lengths, and the red lines are nearer together, while the wave-lengths in the latter part of the spectrum are far apart; and therefore the question was how to pass from a uniform scale used in a spectroscope, in the manner shown by Mr. Procter, to the scale of wave-lengths. He had quite recently found that a uniform scale, used with any spectroscope, like that divided in Mr. Procter's instrument into millimetres, is approximately proportional to a scale of inverse fourth-powers of the wave-length. If, for example, we take the readings of the sodium line, and of any other known line of the spectrum, on a scale of equal parts, and replace them and all the other readings of the scale in proportion by the inverse fourth-powers of the wave-length, we would then find that we can pass from the uniform scale to the wave-length by taking the inverse (or reciprocal) of the readings so replaced, and taking the fourth-root of that reciprocal to obtain the wave-length. It so nearly was the case in all prisms of ordinary dispersion, as to present an almost accurate means of passing without trouble from the uniform scale of the spectroscope to the wave-lengths; and although it is not quite true of the whole range of the spectroscope, yet if used between the short interval of two neighbouring lines to find the wave-length of an intermediate line, it will give the wave-length of that line directly from the milimetre scale.

PROCTER'S DIRECT-VISION MICROMETER SCALE FOR POCKET SPECTROSCOPES.

A A', small direct-vision spectroscope. B B', a parallel brass tube (first slide of a miniature toy telescope) braced to the tube and draw-tube of the spectroscope by the double rings of bent copper plate, *a a*, *b b* (seen also in Fig. 2). The ring, *a*, slides on the main tube of the spectroscope by a collar of soft leather interposed between them. *c c*, small holes about one-eighth inch diameter drilled opposite to each other in the brass tubes for viewing a magnified image of the reading scale, B, reflected in the prism face, *d*. *e f*, a lens of short focus, and thin silvered glass diagonal mirror, cemented on a cork, *g*, in the stopped eye-end of the telescope tube, for obtaining a magnified view of the glass reading scale at B. The latter is marked in transparent lines on an opaque ground, as shown in Fig. 3, and is illuminated by the same direct light as that of which the spectrum is observed.



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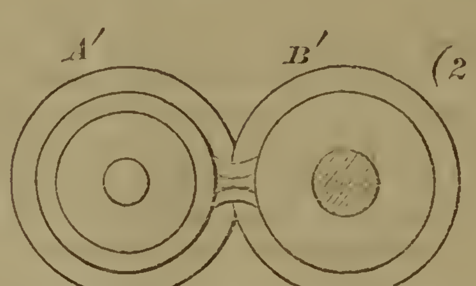

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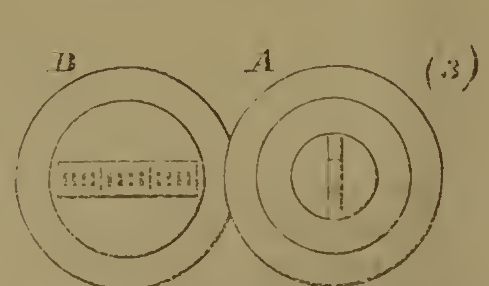

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The Royal Hospital for Diseases of the Chest.—H.R.H. The Duke of Edinburgh will preside at the Fifty-ninth Anniversary Festival of this Hospital, to be held at the City Terminus Hotel, Cannon Street, on Monday, May 19th next.

FRESENIUS AND HIS LABORATORY.

By J. S. UNZICKER, M.D.

Dr. R. Fresenius, although fifty-four years of age, is yet in his prime of life, as regards mental and physical activity. Being one of those few hard workers and original thinkers, he has accomplished much for science and mankind generally. Of his great reputation as a chemist I need not speak—that is well known to all men of science. But as a man also, no one stands higher in the community, nor more respected by all who know him, than he does, for his urbanity and universal kindness toward all who may come in contact with him.

It is not in chemistry alone that he has built up a great reputation, but he has also rendered great services in natural science, public education, agriculture, and manufacturing. All of which he has, and is still aiding by his extensive knowledge and labours. In acknowledgment of this, the Government has conferred upon him the title of "Privy Councillor of Court."

Laboratory.

This is a private institution assisted by the state, but owned and under the entire supervision of Dr. Fresenius. It is located on "Capell strasse" in Wiesbaden. The building is 120 feet front, overlooking the city, with a fine view of the Taunus mountains in the distance.

The laboratory includes three distinct departments:—

1. Qualitative analysis.
2. Quantitative analysis.
3. Manufacturing,

Students entering the institution commence work in the qualitative laboratory, which is a room 24 by 45 feet, well lighted, and accomodating thirty-three students. The room is furnished with a set of Bunsen's filtering pumps, glass blowers, lamps for fusions, and apparatus for keeping up a constant supply of distilled water. By means of large wooden hoods shut off from the laboratory by glass sashes, all noxious vapours are conducted off. Each student has his work table, also a closet with lock and key attached thereto. The course of work consists in the analysis of one hundred different substances of unknown composition. Fresenius visits his students daily, and always expects a detailed account of the work of each; and where a difficulty arises, lays great stress on the importance of every reaction being tried for itself. The quantitative analysis is conducted in a room 24 by 40 feet, having tables for nineteen students, and is fitted with all the necessary apparatus like the first. In this, as well as in the former room, two assistants representing Fresenius are constantly occupied. The quantitative assaying room, accommodating six students, is furnished with a cupel and assay furnaces, &c. HS, as a reagent, is employed only in the open air; for which purpose an apparatus yielding a constant supply and covered by a hood is convenient to each room. The balance-room, containing nine chemical balances, is situated between the two quantitative rooms, and is carefully heated to a constant temperature. The course of work in the quantitative department consists in the analysis of about fifty different minerals; alkalies, ores, paints, dye stuffs, coal, soap, and manure; fire assays and elementary analysis of sugar, starch, gum, gas analysis, &c. All quick and practical methods for purely technical purposes are here most thoroughly worked out, and students can fit themselves to become at once chemists in all branches of manufacture.

In the manufacturing department, the chemical reagents used in the Institution are made in a state of almost absolute purity by an experienced assistant of Fresenius. In the furnace-room you will find sand-baths and retorts for the purification of acids, &c. Here instruction is given in special branches of manufacture, as of aniline colours, crystallised salts, &c. The library room contains a complete selection of all standard works and journals relating to chemistry and all branches connected therewith, where students can retire for consultation. The store-room contains a complete selection of chemical apparatus, where students can supply themselves at low rates. There are also two lecture-rooms; a private test-room, with analytical balances and other apparatus, to prove the correctness of important analysis. Next comes the private laboratory, library, study, and reception rooms of Fresenius. The best students, after completing their studies, are generally allowed to become private assistants to Fresenius in his own laboratory. These positions are much sought after, yielding no pay, but affording the greatest opportunities for more perfect and practical experience. Students have to provide themselves with all the small utensils and apparatus necessary, but all large ones are loaned to them by the Institution. The pharmaceutical department connected with the Institution is also assisted by the State. The summer semester (course) begins April 24th, and continues four months. The winter semester begins October 15th, and continues four and a half months. The charges are very moderate, being only, for a full laboratory course of one semester, £7 7s. It is, however, optional with students to work as many days in the laboratory as they please, for which proper deduction is made. This arrangement or declaration must be made at the beginning of the session.

The honorary fees for the lectures of the Institution are as follows:—

	£	s.	d.
Experimental chemistry, first division	1	5	6
" " second division	1	5	6
Organic chemistry	1	5	6
Special theoretic chemistry	0	13	9
Experimental physics, first division	0	17	9
" " second division	0	17	9
Botany, first division	0	17	9
" second division	0	17	9
Zoology	0	17	9
Mineralogy	0	17	9
Pharmaceutical chemistry	1	1	0
Pharmacognoscy	1	1	0
Repetitorium on pharmacy	0	10	3
Chemical technology, inorganic division	0	13	9
" " organic division	0	13	9

By this it will be seen that this Institution offers advantages not easily found elsewhere. Manufacturers and advanced chemists, who wish to perfect themselves practically in some special branches, will find no better opportunities than here, under so renowned a teacher, who is master of his art. Wiesbaden is one of the most charming places to live in, and as the surrounding country offers great advantages for the study of botany, weekly excursions are made by the professor of botany during the summer semester, giving a chance to each student to pursue his studies practically and collect a nice herbarium for himself.

May this good Institution long continue in its present flourishing condition, and may the young chemists issuing therefrom never forget their "alma mater," and in their future professional lives try and imitate their great teacher.

DRAPER AND TYNDALL ON THE INVISIBLE RAYS.

The following appears in the *Scientific American*:—

In Prof. Tyndall's lecture on "The Invisible Rays," the following statements occur. "On both sides of the spectrum there is a copious overflow of rays which are incompetent to excite vision, but which, however, are able to agitate the molecules of certain substances so as to shake them asunder and produce chemical decomposition;" and, further on, "It is shown that the heat radiated from the

non-luminous portion is seven or eight times as great as from the luminous or visible." The latter proposition is illustrated by a well-known figure, in which the invisible rays are represented by a curve very large in comparison with a similar line indicating the visible rays. In the same number of your journal you publish Dr. J. W. Draper's researches in actino-chemistry, in which the author says—"As Dr. Draper demonstrated the heating power of radiation to reside in all equally, whatever their refrangibility, so in this he proves the power to produce chemical changes to be manifested by rays of every refrangibility, different substances being acted on by different rays." The discrepancy apparently existing between the views of Drs. Draper and Tyndall, thus plainly indicated by the two articles from which the above extracts are made, has led me to obtain a more extended report of the investigations of the former physicist. The conclusions therein contained seem to me to be flat contradictions of Prof. Tyndall's assertions, as proved by the following:—It follows that the true distribution of heat throughout the spaces of the spectrum is equal, and that "the figure so generally employed in works on actino-chemistry to indicate the distribution of heat, light, and actinism in the spectrum, serves only to mislead. The heat curve is determined by *the action of the prism, not by the properties of calorific radiations;* the actinic curve does not represent any special peculiarities of the spectrum, but the habitudes of certain compounds of silver." Can you or any of your readers reconcile such completely opposite ideas? How is it that Prof. Tyndall did not allude to so radically different a theory, of the existence of which he must have been aware, in the course of his lectures? When such eminent and learned doctors disagree, it is indeed a question who is to decide.—A Perplexed Physicist.

Remarks by the Editor.—The discrepancy between the views of Dr. Draper and Dr. Tyndall, pointed out by our correspondent, did not escape the attention of scientific men during the visit of the latter to this county; and the subject was frequently discussed by them without the friends of either party being able to reconcile the differences. Dr. Draper, we are told, is disposed to think that the spaces in and out of the spectrum measured by Dr. Tyndall were so small that the chance for error was a very close one, and he intimates that an error was probably committed. On the other hand, Dr. Tyndall does not appear to believe in Dr. Draper's results. We suspect that Prof. Tyndall did not allude to the radically different theory, of which he was fully aware, partly because it might have been considered a breach of hospitality and partly because the rostrum of a public lecture is not the place for the discussion of such nice points of physics. The question is one which can only be determined by actual experiment. The learned doctors must repeat their observations, and, if they still disagree, let a high court of arbitrators appoint competent physicists to go carefully over the same ground and report the results to a scientific congress. We take the opportunity to say that, in our opinion, Dr. Draper has never received the credit that fairly belongs to him for his early researches in prismatic analysis. In the *Philosophical Magazine* for May, 1847, and February, 1848, are contained papers "On Methods for the Prismatic Analysis of Substances," in which will be found foreshadowed Bunsen's application of the spectroscope to chemical analysis. Bunsen at first proposed to substitute prismatic analysis for flame analysis as an aid to qualitative chemistry. In this he had been anticipated by Draper, but Bunsen went further and discovered a new element; that event fixed the method beyond all possibility of being forgotten, and Kirchhoff clinched the matter by his magnificent researches in solar chemistry. Still it must not be forgotten that Draper pointed out this line of research fourteen years before Bunsen took it up, and that if he had not been loaded down with the cares of administration and the toil and drudgery of teaching, he too might have pursued it to such a degree of perfection that no subsequent doubt could have arisen as to his share in the great discovery. The present is a good time to revive these points of history, and to accord credit where it belongs.

CORRESPONDENCE.

DECOMPOSITION OF SULPHURIC ACID BY HYDROGEN IN THE PORES OF CARBON.

To the Editor of the Chemical News.

Sir,—I see that Mr. Skey, writing from New Zealand, thinks this apparent phenomenon is due either to the previous absorption of sulphuretted hydrogen from the atmosphere or from the presence of sulphides in the carbon.

If anyone will take a porous jar, with a plate of carbon in the middle packed round with broken pieces of carbon, and form it into a battery with amalgamated zinc, and dilute sulphuric acid for an electrolyte, and set it to work through a moderate resistance—say 20 ohms—for twelve hours, I think he will find the evolution of sulphuretted hydrogen too great to be thus accounted for.

An easy *experimentum crucis* would be to keep on renewing the sulphuric acid till all sulphides accidentally present must be fully decomposed, and seeing whether the evolution of sulphuretted hydrogen still went on.

Why should not nascent hydrogen, in the pores of the carbon, form, with sulphuric acid, water and sulphuretted hydrogen? It is quite according to the analogy of other chemical facts.—I am, &c.,

H. Highton.

Putney, March 17, 1873.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

Sir,—In answer to Mr. McCulloch's observations in his paper on the manufacture of sulphuric acid (Chemical News, vol. xxvii., p. 135), allow me to say that with a *properly proportioned and worked* Glover's tower none of the drawbacks to its use mentioned by him exists. I have used a tower five years without interfering with the original packing, aad after six years' constant use the lead is still in good condition. So far from the acid being imperfectly denitrated, or containing any of the higher oxides of nitrogen, it frequently smells strongly of SO_2. The same apparatus, in converting 1651 tons of sulphur (from Norwegian pyrites) into acid, required 63 tons 13 cwts. of nitre, or 3·8 per cent, chamber space being 1 S per twenty-four hours to 20 cubic feet, thus showing a much greater economy of chamber room than that described by Mr. McCulloch; at the same time *all* the acid so made was concentrated to 140° to 150° T. by the heat from the pyrites kilns alone. Similar apparatus, fitted up from our plans and under our advice, have given even better results than the above. Mr. McCulloch is right in his observation, that heat alone will not denitrate sulphuric acid, but concentration by heat *in an atmosphere of* SO_2 does it thoroughly.—I am, &c.,

John Glover.

Wallsend, Newcastle-on-Tyne,
March 24, 1873.

MISCELLANEOUS.

Dr. Fresenius's Laboratory.—Mr. Harry G. Shaw writes to say that a great jubilee, in commemoration of the twenty-fifth year of foundation of the institution of Dr. Fresenius's Laboratory, will be held from the 2nd to 4th May, where Bunsen, Liebig, Mohr, and other eminent Chemists, together with the former students of Fresenius, are expected to attend.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 17, 1873.

The following original papers and memoirs more particularly relating to chemistry are published in this number:—

Heat set Free by the Reaction of the Hydracids and Water, and on the Molecular Volume of the Solutions thus Formed.—This exhaustive monograph, elucidated by a large number of tables and algebraical formulæ, treats on the degree of heat developed by the union (combination) of chlorhydric, bromhydric, and iodhydric acids with water, and also on the amount of heat set free by the reaction of the caustic alkalies—potassa, soda, ammonia—with water. The heat set free by dissolving these substances in water, and also by diluting their concentrated solutions with water, has been measured with great care by the aid of a peculiarly constructed calorimeter, somewhat different from that applied to analogous experiments by Favre and Silbermann. The Berthelot calorimeter consists of an outer copper vessel, in which there is placed at some distance a similar but smaller one, the inside being plated with silver. The calorimeter, properly so called, which is made of platinum; is placed in this vessel; its capacity can be varied, and is comprised between 600 and 1000 c.c. The employment of this large calorimeter has the effect of perceptibly diminishing 1-200th of a degree during a quarter of an hour, the variation of temperature due to the action of other objects. The reactions to be investigated can be made in the calorimeter itself. By a series of experiments the author has found that the heat set free by the solution of any of the three hydracids varies in the ratio of the quantity of water already combined with the same; in other words, the quantity of heat set free in the solution, or in the mixture of a quantity of pure acid and equal quantity of water, is constant, and this holds good for the three hydracids.

On Spectrometry; Spectronatrometry.—P. Champion, H. Pellet, M. Grenier.—This essay, illustrated by woodcuts, treats on a spectrometrical process for the estimation of soda; but without the reproduction of the woodcut no further details can be given. There is added to this paper an appendix under the following title:—

On Quantitative Spectrum Analysis.—M. Janssen.

Critical Remarks concerning a Paper Recently Published by Gernez "On the Crystallisation of Supersaturated Saline Solutions.—Ch. Violette.

La Revue Scientifique de la France et de l'Etranger, March 22, 1873.

Contains no papers relating to chemistry, but attention is called to the following memoirs:—

Genealogical Classification of the Animal Kingdom.—Dr. Haeckel.

The Development of Scientific Medicine.—Dr. Cl. Bernard.

Bulletin de la Société Chimique de Paris, No. 5, 1873.

The original papers and memoirs published in this number having previously been published in the *Comptes Rendus* have been already noticed.

No. 6, 1873.

From the *proces-verbaux* of the meetings of this society we quote the following:—

Estimation of the Oxygen in Blood by Means of the Hydrosulphite of Sodium.—P. Schützenberger and Ch. Risler.—Blood kept in an atmosphere of hydrogen, and diluted with 100 times its own bulk of water previously freed from oxygen, was found to yield about one and a half times more oxygen than can be obtained from the blood—previously well mixed with air—by aid of exhaustion with the air-pump.

Isomers of Bibromo-Succinic Acid.—P. Franchimont.—For the purpose of priority the author briefly mentions that, while preparing bibromo-succinic acid at a temperature of 130° to 140°, he believes he has obtained two isomeric acids, which can be separated from each other by repeated crystallisation in boiling water, but then the isodibromo-succinic acid is decomposed into bromhydric and bromomaleic acids; by further causing sodacetic ether to act upon this acid there is formed aconitric acid. This latter—but obtained from acidbromomalate of sodium—the author has tried to convert into citric acid.

Carburets of the Terebic Series.—M. Ribau.—Pure tereben, prepared by Deville's process, has been more particularly investigated. The body alluded to consists of cymen, boiling at between 175° and 177° (due to the incomplete combustion of the tereben by the oxygen of the sulphuric acid), and genuine tereben, boiling at 155°, not possessed of optical rotatory power, becoming solidified by contact with hydrochloric acid, forming crystalline chlorhydrate of tereben isomeric with the corresponding chlorhydrate of terebenthene. The former body is decomposed by cold water, yielding hydrochloric acid and a new hydrocarbon, $C_{10}H_{16}$, in active β-camphen. Among other substances obtained by fractional distillation from the cymen is a solid material, which, in its physical properties, is similar to the camphor obtained from the *Laurus* species; it fuses at 169°.

Marsh-Gas from Methylic Alcohol.—E. J. Maumené.—The author states that by the incomplete combustion of methylic alcohol in a specially constructed apparatus, marsh-gas has been obtained by him.

Decomposition of Nitrate of Potassa by Continued Boiling of its Aqueous Solution.—E. J. Maumené.—Since Lavoisier's investigation of this subject, it has always been held that the loss experienced by the continued boiling (evaporation) of an aqueous solution of the salt alluded to is due to particles of that salt being mechanically carried off with the steam. But the author states that the result of his investigation is the dissociation of the nitric acid, and consequently the formation of caustic potassa, which is actually found in the solution.

This number contains no other original matter.

Les Mondes, March 20, 1873.

Hydrothermic Engine.—D. Tommasi.—From the short account here published it would appear that the author has constructed a mechanism, the motive power of which is derived from the expansion of oil by heat. A more complete description is promised shortly; but this contrivance seems to offer great advantages over steam, inasmuch as—(1) no explosions of boilers can take place; (2) 80 per cent less space is required for the apparatus; (3) cheapness; (4) economy of fuel.

Artificial Production of Ice.—P. Giffard and J. Armengaud.—With the machinery as now constructed, and as yet imperfect, the authors have succeeded in making 20 kilos. of ice per minute while working with a 5-horse power high pressure engine, so economically constructed that for 1 kilo. of fuel used 2 kilos. of ice are obtained. On this same subject the last-named author publishes a lengthy mechanico-physical essay.

Petites Annales de Chimie.—E. J. Maumené.—The thirteenth instalment of this monograph, this portion treating on the chemical action produced by the galvanic current.

Use of Ammonia in the Looking-Glass Amalgam-Covering Works.—J. Meyer.—The author states that the injurious effects of the mercury upon the workmen engaged in this so-called silvering—really amalgamising with tin and mercury—of mirrors and looking-glasses, may be prevented by sprinkling from one-half to 1 litre of strong ammonia every evening on the floor of the workshop.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

614. C. Chanel, Rue de la Fidélité, Paris, "An improved fuel."—Petition recorded February 19, 1873.

684. S. Rowbotham, Kentish Town, London, and G. Richardson, Chignal St. James, near Chelmsford, Essex, "Improvements in the composition of artificial marbles, stones, and cements of every kind, in making them firmer, harder, less absorbent, and more able to bear exposure to air, water, and other influences than hitherto, which improvements are applicable to the making of paints, and as a substitute for leather and other like fabrics."—Petition recorded February 24, 1873.

743. R. K. Whitehead, Walmersley, near Bury, Lancashire, "Improvements in the manufacture of size."

744. T. Cadett, Rosherville, Kent, "An improved artificial fuel."—Petitions recorded February 28, 1873.

758. J. C. A. Henderson, Wood Street, London, "Improvements in the treatment of peat, and in apparatus therefor, part of which is applicable to other purposes."—Petition recorded March 1, 1873.

766. E. Hunt, Salford, Lancashire, "An improvement in dyeing and fixing what are known as aniline colours."—Petition recorded March 3, 1873.

783. E. Hunt and G. M. Hopwood, Salford, Lancashire, "Improvements in treating catechus, cutch, or gambier, to obtain products therefrom suitable for use in tanning, dyeing, and printing."—Petition recorded March 4, 1873.

795. W. R. Lake, Southampton Buildings, London, "An improved manufacture of coloured or ornamented paper, cloth, and other similar materials, and processes and compounds employed therefor."—A communication from F. Beck, New York, U.S.A.

799. B. Hunt, Serle Street, Lincoln's Inn, Middlesex, "Improved

processes for the extraction of iodine."—Petitions recorded March 5, 1873.

828. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphates of soda and of potassa, and in the production of chlorine."—Petition recorded March 7, 1873.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

803. W. Mickle, Tynemouth, Northumberland, "Improvements in smelting and puddling iron."—Petition recorded March 5, 1873.

NOTICES TO PROCEED.

3202. W. Thompson, Wandsworth Road, Surrey, "Improvements in the manufacture of white-lead, and apparatus therefor."—Petition recorded October 29, 1872.

3261. J. A. Wanklyn, Hampstead Road, Middlesex, "Improvements in the production of oxygen gas."—Petition recorded November 2, 1872.

3308. M. Rae, Uphall, Linlithgowshire, N.B., "Improvements in the production of artificial fuel, and in the machinery employed therein."—Petition recorded November 7, 1872.

3322. W. Marriott, Huddersfield, Yorkshire, "Improvements in the manufacture of salts and oxides of lead, and in apparatus therefor."—Petition recorded November 8, 1872.

3350. H. H. Murdoch, Staple Inn, Middlesex, "An improved mode of tanning hides and skins."—A communication from B. Picard, Paris.—Petition recorded November 11, 1872.

3736. W. R. Lake, Southampton Buildings, London, "An improved insulating compound for telegraphic purposes."—A communication from Z. G. Simmons, Kenosha, Winconsin, U.S.A.—Petition recorded December 9, 1872.

547. J. G. Willans, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."—Petition recorded February 14, 1873.

728. A. E. Webb, Stepney, Middlesex, "Improvements in candles and night-lights, and in the treatment of materials therefor."

732. J. G. Redman, New Brompton, Kent, "Improvements in compositions for preventing the corrosion and the fouling of ships' bottoms or other submerged structures."—Petitions recorded February 27, 1873.

PATENTS SEALED.

2569. B. W. Gerland, Ph.D., Macclesfield, Cheshire, and E. Johnson, Dartmouth Park, near Sydenham, Kent, "Improvements in the manufacture of sanitary charcoal, and the application thereof to the treatment of sewage."—Dated August 29, 1872.

2693. S. J. Mackie, Delahay Street, Westminster, "Improvements in the manufacture and storing of gun-cotton."—Dated September 11, 1872.

2704. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphate of soda."—Dated September 12, 1872.

2855. J. McKelvie, Edinburgh, N.B., "Improvements in the manufacture of illuminating-gas."—Dated September 27, 1872.

3588. A. V. Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of sugar, and in apparatus to be used therefor."—A communication from S. Dod, Havana, Cuba.—Dated November 28, 1872.

3843. G. Haseltine, Southampton Buildings, London, "An improved method of, and apparatus for, rendering and drying animal matter, deodorising noxious gases, and treating blood to utilise it for agricultural and similar purposes."—A communication from J. J. Craven, Jersey, N.J., U.S.A.—Dated December 18, 1872.

3919. T. Williams, Roath, near Cardiff, Glamorganshire, "Improved combinations of materials for the manufacture of fire-bricks, retorts, and crucibles, linings for furnaces, cupolas, and vessels in which great heat is employed."—Dated December 26, 1872.

50. P. Spence, Manchester, "Improvements in obtaining valuable substances derivable from residual liquors produced in the manufacture of alum from natural phosphates of alumina."—Dated January 4, 1873.

NOTES AND QUERIES.

Portable Dry Ink.—At a recent meeting of the Frankfort Polytechnic Association, Professor Boettger exhibited a novel kind of ink, which is admirably adapted to take on journeys and exploring expeditions. White blotting-paper is saturated with aniline black, and several sheets are pasted to form a thin pad. When wanted for use, a small piece is torn off and covered with a little water. The black liquid which dissolves out is a good writing ink. A square inch of the paper will give enough ink to last for considerable writing, and a few pads would be all that an exploring party need carry with them. As water is always available, the ink is readily made.

Extracts from Dr. Guyot, "On the Forms and Forces of Matter," *Phil. Mag.*, vol. xli., p. 405 *et seq.*:—

P. 408.—"The subject which I am about to attack is so vast and difficult to explain that I cannot commence it without having previously asked for the kind and patient attention of my readers. I shall certainly announce a number of propositions which will appear more than doubtful, and I cannot stop to discuss and prove them one by one; but, by the patience and kindness of my readers, they will become evident as they are developed. I therefore ask for provisional faith, and I think it is in harmony with the spirit of my readers to grant me this preliminary faith in regard to all matters advanced, with the reserved privilege of judicially deciding after having heard. In fact, knowledge acquired and established bases its arguments on the principles and facts which it has accepted." . . . . . "It is often observed that learned official bodies energetically and for a long time reject truths and facts which afterwards take first rank amongst those adopted by science."

P. 409.—"Atomic elements are exceedingly few in number; twelve or thirteen metalloids and forty or fifty metals suffice to give rise to the millions of varied forms of all the bodies which we know on the earth." . . . . . "Such is the totality of the forms assumed by pressible ponderable matter which is atomised (that is, grouped in atoms), a totality which extends to the whole universe and occupies all space. I say that this matter grouped in atoms *occupies* all the universe; I do not say that it *fills* it, because the universe is *filled* by elementary matter,—simple, subtle, impressible, imponderable, not atomised or grouped in atoms. Not but that its element is an atom, for it is indeed the absolute atom; but this atom is free from all combination: it is infinitely more subtle than any atom of coercible matter.

"The existence of this incoercible matter has always been admitted by the greatest philosophers and the greatest physicists under the name of the subtle substance, or more generally æther.

"Æther, in fact, constitutes the fourth state and the fourth medium of matter. It is the most abundant of the states; it is the medium of media. It contains all the stars." . . . . "All space void of coercible matter is occupied by it. Not only is there no such thing as an absolute vacuum in nature, but, on the contrary, ponderable and imponderable matter are in an absolute and relative condition of enormous tension. The equilibrium and the phenomena of the world only exist under the condition of the constant pressure of the incoercible matter upon the coercible matter, and the reaction of the coercible matter upon the incoercible."

"The approximation of the atoms of ponderable matter may therefore be due to the rarefaction of the imponderable fluid, and consequently to the diminution of its pressure in the space separating the atoms of the same body. And this approximation will be greatest and strongest accordingly as the interior rarefaction is greater, the exterior pressure being inversely as the interior. This hypothesis would be more than probable, it would be true, if it were shown that the vibration of the atoms of bodies may, and actually does, cause a rarefaction in the sphere of activity of each of the atoms.

"If this proof could be given, we should be obliged to admit that attraction is a mechanical force, composed (1) of the rarefaction of the æther in the interior of substances, of media, of heavenly bodies, brought about by the power of vibration of the atoms of ponderable matter; (2) of the reaction of the pressure of the exterior æther upon substances, media, and heavenly bodies—a reaction measured by the general tension of the imponderable and incoercible fluid which constitutes the mother-liquor *(Eaux mères)* of the world, the universal medium."

P. 418.—"That which occurs with vibrating bodies plunged in air ought to, and really does, occur in the case of atoms of coercible and ponderable matter plunged in æther, because no other explanation is possible of the phenomena of the formation of solid, liquid, and gaseous bodies, and of their transformation one into the other, of their elasticity, dilatability, solubility (affinities of the tension of media and of heavenly bodies), of the weight of bodies, of gravitation—in one word, of universal attraction,—and because this explanation is in accordance with those phenomena which we can see and measure."

MEETINGS FOR THE WEEK.

Monday, March 31st.—Medical, 8.
—— Chemical, 8. Anniversary.
Tuesday, April 1st.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
—— Zoological, 8½.
Wednesday, 2nd.—Society of Arts, 8.
—— Pharmaceutical, 8.
—— Microscopical, 8.
Thursday, 3rd.—Royal, 8½.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
—— Royal Society Club, 6.
—— Chemical, 8. Dr. H. Sprengel, "A way of exactly Determining the Specific Gravity of Liquids." Dr. C. R. A. Wright, "On Cymene from various Sources." Dr. J. H. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; II. On the Iodides of Amyl and Methyl." Dr. H. E. Armstrong, "Contributions from the Laboratory of the London Institution; No. XI. Action of the Acid Chlorides on Nitrates and Nitrites."
Friday, 4th.—Royal Institution, 9. Prof. Tyndall, "Some Observations on Niagara, made during a Visit to the United States."
—— Geologist's Association, 8.
Saturday, 5th.—Royal Institution, 3. Prof. Max Muller, LL.D., "On Darwin's Philosophy of Language."

TO CORRESPONDENTS.

A Constant Reader.—The complete paper has been published in the *Brewers' Journal.*

H. Cant.—Erdman's *Journal fur Praktische Chemie* is a periodical of high value: it is now edited by Dr. Kolbe, but only occasionally are the various combinations of aniline mentioned. The journal is published at Leipzig, and is found in many of the libraries in this country. A work is in the press which will give all the information you require.

SUPPLEMENT
TO
THE CHEMICAL NEWS.

Vol. XXVII. No. 696.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 20th, 1873.

Professor Frankland, D.C.L., F.R.S., President, in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, the list of donations to the Society was read. The names read for the first time were those of Messrs. James Hughes and Henry Tylston Hodgson, M.A.; for the third time—Messrs. Andrew F. Crosse, Thomas Futcher Best, W. Ramsay, James William Bantock, and Frederick Douglas Brown.

The President then called on Dr. Siemens to deliver his lecture "*On Iron and Steel.*" The lecturer first adverted to the discourse delivered by him before the Society in 1868, on the regenerating gas furnace as applied to the production of steel, briefly describing one of the processes for that purpose, viz., that of fusing the pig-iron on a hearth, which, in order to resist the great heat, should, like the vault, be of nearly pure silica, and then adding scrap-iron, which dissolves in the fluid metal, forming steel. He then proceeded to describe the action of the blast-furnace, which, notwithstanding the opinion expressed by Mr. Riley in his lecture, he must maintain was not the best apparatus, theoretically considered, for the production of iron, pointing out that the ore is reduced at a comparatively low temperature in the upper part of the furnace forming a kind of metallic sponge, which, as it sinks, comes to a hotter zone of the furnace and there takes up sulphur, phosphorus, and other impurities; moreover, there is an enormous loss of fuel, the carbon escaping at the mouth almost entirely (4-5ths) as carbonic oxide, and not as carbonic acid. A pound of carbon burning to carbonic oxide only evolves 2400 heat units, whilst if burnt to carbonic acid it evolves 8000 heat units; so that nearly two-thirds of the heating power is lost in the blast-furnace. Dr. Siemens also noticed the advantages of the hot blast, and the effect of introducing a secondary blast near the top of the furnace.

Considering that at the comparatively low temperature at which the ore is reduced to a metallic sponge in the blast-furnace, it does not become contaminated with the sulphur, phosphorus, and other impurities so detrimental in the production of good steel, the speaker had invented a revolving furnace in which the ore could be reduced in this manner, and then be allowed to fall into the pig fused on a hearth, as in the process previously described; but here a great obstacle occurred, from the light metallic sponge floating on the surface of the molten metal.

In order, if possible, to avoid the spongy state altogether, the experiment was tried of fusing the ore and running it into moulds partly filled with coke, so that the two might be intimately mixed. These bricks were then added to the molten metal on the hearth, in hopes that they would be there reduced and convert it into steel; it was found, however, that this was not the case, the effect being much the same as when ore was added unmixed with coke. It was therefore determined to fuse the ore, and while in this condition, to mix it intimately with sufficient carbonaceous matter to effect its reduction. This was done by fusing the ore in the upper hearth of a double furnace, and when melted, ladling or tapping it off on to the lower hearth, where it was mixed with the requisite quantity of powdered coke by manual labour in a manner analogous to puddling. It was then found that the iron was immediately precipitated from the molten mass in the metallic state. The hearth of this furnace was made of the ore itself, and the results obtained were satisfactory, but a great amount of manual labour was required to mix the ore with the carbonaceous matter. An effort was therefore made to obtain the desired result by machinery. The process was conducted in a revolving furnace lined with refractory bricks, capable not only of withstanding the intense heat required to fuse the ore, but also the action of fused metallic oxides. The bricks were made from "Bauxite,"—a mineral consisting chiefly of alumina with some ferric oxide,—mixed with about 5 per cent of plumbago and some silicate of soda. The ore is introduced into the furnace, which revolves very slowly at first, and is there heated to a very high temperature, but one insufficient to melt the iron peroxide; a portion of the coal, about 20 per cent of the whole, is now introduced, so as to reduce the charge to the state of magnetic oxide, which is comparatively fusible; the rest of the fuel is then added, and the furnace caused to rotate rapidly, so that the particles of iron precipitated in the mass may ball together. Three of these balls are produced in each furnace, by the interior lining having projecting ribs for that purpose. This process is perfectly successful in producing a wrought-iron free from sulphur, &c., and which dissolves in the bath of melted pig like sugar in water, forming a steel equal in quality to that obtained from the best Swedish bar. The economy of time and fuel also is very great, the whole operation only occupying about two hours, and the amount of fuel consumed being altogether about 1½ tons per ton of iron produced.

During the course of his masterly lecture, which was illustrated by numerous diagrams, specimens, and tables, the speaker compared the ancient process of smelting, as practised to this day in India, with the Catalan forge and the blast-furnace, and also explained why it was always necessary to add manganese (in the form of spiegeleisen) in his process for preparing steel, although it was not necessary in the Bessemer process if the iron already contained it. In the latter case the free oxygen blown in oxidised, by preference, the silicon and as much iron as would form a tribasic silicate, leaving the manganese untouched; whilst in the former instance, on adding oxide of iron to it, the manganese became oxidised.

The President said that the members, by their acclamations, had anticipated the vote of thanks he was about to propose to Dr. Siemens for his instructive lecture, the subject of which he had treated with such a master mind. He had conducted his experiments in the true spirit of philosophy, and had attained, what all philosophers did not, a most important practical result; for not only was he able to produce steel of such excellent quality, but at the same time used only a comparatively small quantity of coal.

Mr. L. Bell remarked that he was comparatively little acquainted with the working of the new process, but was surprised at the very small amount of fuel required to reduce the oxide of iron to malleable iron. He must confess to a great fondness for the blast-furnace, and should be sorry to see it replaced. It must be remembered that, although carbonic oxide is a powerful reducer, carbonic acid is a powerful oxidiser, therefore in the blast-furnace the conversion of the carbon into carbonic oxide was a defect inseparable from the process itself. The great mass of matter at the furnace above the tuyeres intercepts a great deal of heat, so that the gases issuing from the mouth had only a temperature of about 650°; moreover, the furnace being large and its sides thick, the loss by convection and radiation was small compared with what it must be in that of Dr. Siemens.

Dr. Siemens replied that he had been obliged to allude to the blast-furnace, in order to point out the advantages of the new method; he did not wish to decry the blast-furnace, which was in many respects an admirable instrument. The small amount of fuel employed in the regenerating-furnace is easily accounted for; in it the carbon is all burnt to carbonic acid, whilst in the blast-furnace it issues as carbonic oxide. Moreover, the temperature of the gas in the former case is 300°, in the latter 650°, so that, from the same amount of fuel, he obtained more than three times the calorific effect, and the gases passed out of the chimney at a temperature 350° lower, leaving a large margin for the difference in radiation and convection.

Professor Williamson remarked that, although the blast-furnace had been greatly improved, it was utterly faulty in principle. The greatest possible amount of heating effect was not obtained from the fuel, and, as Mr. Bell had confessed, if the gases were made hotter the carbon present was burnt by the carbonic acid to carbonic oxide. It was almost impossible to appreciate and recognise too highly the value of introducing correct principles into so vast a manufacture, as it was manifest that the lecturer had been enabled to do through the wonderful command of heat obtained by the use of his regenerating-furnace.

Mr. Riley said that he quite agreed with the remarks of Mr. Bell, and although this process might do for rich ores, he could not conceive how poor ones, such as the clayband, could be treated by it, from the great amount of cinder they would produce.

Mr. Mattieu Williams observed that he fully appreciated the great importance of escaping the spongy state, in which the metal so readily took up sulphur, &c., as some experiments he had once made would serve to illustrate. He had imagined that sulphur in the fuel employed in the puddling-furnace would be very injurious to the quality of the iron, and, in order to test this, he employed a poor coal as fuel, but found that it did not produce any change in the quality of the iron, and, even when considerable quantities of pyrites were thrown into the furnace, the effects remained the same. This might, perhaps, be explained by the coating of slag covering and protecting the iron from the action of the sulphur.

Dr. Siemens, in replying, said that Mr. Riley was right in supposing his description to apply to the richer varieties of ore, but he had worked poor ones. The Cleveland ores produce an iron chemically purer than when prepared by the blast- and puddling-furnaces. It is, however, with the richer ores that the saving is so great, since even very inferior fuels can be used. In reply to a question asked by Dr. Wright, he might say that the essential difference between the blast-furnace and the rotating-furnace was that in the latter the heat is not developed in the interior, but on the surface, of the mass, from which carbonic oxide is continually issuing during the reduction, so that the metal is protected from the action of the carbonic acid, whilst the burning carbonic oxide heats that part of the internal surface of the furnace which happens to form the arch, and which, as it rotated, would in turn become the bottom.

The President, after recapitulating the advantages of Dr. Siemens's process, adjourned the meeting until Monday, March 31, when the anniversary meeting will be held. The next ordinary meeting is on Thursday, April 3, when the following papers will be read:—1. "A way of exactly Determining the Specific Gravity of Liquids," by Dr. H. Sprengel. 2. "On Cymene from various Sources," by Dr. C. R. A. Wright. 3. "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; II. On the Iodides of Amyl and Methyl," by J. H. Gladstone, F.R.S., and A. Tribe. 4. "Contributions from the Laboratory of the London Institution; No. XI. Action of the Acid Chlorides on Nitrates and Nitrites," by Dr. H. E. Armstrong.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

Inaugural Address of the President, Dr. Lunge, Ph.D., F.C.S.

(Concluded from p. 141.)

Unfortunately, the solution of sodium bicarbonate can hardly be utilised for obtaining solid bicarbonate therefrom; at least, I never succeeded in anything like that, and therefore proceeded to boil it down, during which process the second equivalent of carbonic acid is driven off, and can be collected in a gasholder or otherwise for further use. The dry residue of evaporation is furnaced, and constitutes an alkali of most complete purity, equal in colour to the best refined alkali, and surpassing it in the complete absence of all but traces of foreign salts, if the sodium sulphate had been sufficiently pure. It is well known that all traces of iron would be completely removed by the barium carbonate, which is a reaction utilised in analytical chemistry; no alumina, or silica, or lower sulphur compounds of sodium would ever get into the product at all. The quantity of soda thus obtained is the one to be expected theoretically from the sulphate employed; in my experiments I obtained sometimes as much as 99½ per cent of sodium carbonate, of the quantity calculated from the sulphate weighed into the apparatus, and allowing for the impurities of the latter. I need hardly remind you that the loss of available alkali in Leblanc's process, with the greatest care, amounts to 12 or 15 per cent of the theoretically obtainable quantity, partly in consequence of mechanical losses or volatilisation, but mostly in the shape of undecomposed or re-formed sulphate, and of soluble or insoluble sodium compounds left in the tank waste.

I must mention at this point, that another Continental professor, Mr. C. Brunner, independently of me, and before my specification was published, has, like myself, proposed the reaction of carbonic acid on a mixture of sodium sulphate in solution and barium carbonate. I was, of course, on my part, perfectly unaware that Mr. Brunner was making such experiments whilst I was making my own; but I must say, having read his paper for the first time some time after my final specification was filed, that I could not have extracted any suggestions of value from it, even if I had seen it sooner. The Professor very naïvely says, that he must leave it to practical men to say whether his proposal is realisable in an economical point of view, in other words, whether it will *pay*, and you may judge of its value as it stands, if I tell you that he proposes, where native witherite should be unobtainable, to make artificial barium carbonate by first reducing barium sulphate in *crucibles*, with powdered coal and resin; that he prescribes to make the carbonic acid by means of hydrochloric acid, *very* naïvely remarking, that the whole of the hydrochloric acid obtained in the manufacture of the sulphate of soda would not be sufficient for this process, and that the sulphuretted hydrogen escaping in the decomposition of the barium sulphide does not give him so much concern as to elicit a single word from him about its disposal. After this, I need not say that Brunner's proposal is utterly theoretical, and, if I did not think my own process essentially different in this respect, I should not venture to lay it before this audience, even in the shape of a suggestion.

I should also mention that some time after I had taken out my patent, my attention was drawn to a patent obtained so far back as 1851, by Herbert Taylor, as a communication from a foreigner, not named. In that short specification, there are, among a whole heap of other things, five or six lines shadowing forth the same reaction; but, in the first instance, there are no details whatever given, nor is there the least hint how the reaction could be put into practice as part of a manufacturing process, and in the second instance, the addition that the use of the carbonic acid is *optional*, and the total ignoring of the formation of bicarbonates and the part they

play, shows that the matter in the mind of the unknown inventor had remained in a totally inceptive stage; and it is not to be wondered at that Taylor's statement has hitherto completely escaped the attention of the most diligent collectors of materials for the history of alkali making, to whom I herewith beg to make a present of it. I am quite unaware of the same reaction having been proposed anywhere else.

Brunner's most simple, if not very cheap, plan of obtaining his carbonic acid, leads me to say something upon the way in which I proposed to produce that gas. It is quite clear that the purer it can be obtained the better it is for the process. If, for instance, Ozouf's plan for obtaining pure carbonic acid were practicable on the large scale and sufficiently economical, it would come in very well for my process. Ozouf's proposal, it is well known, consists in pumping impure carbonic acid, mixed with any amount of air, nitrogen, &c., into a solution of ordinary sodium carbonate, when the foreign gases escape, whilst the carbonic acid is retained to form sodium bicarbonate. When the absorption has reached its maximum, the solution is drawn off and replaced by a fresh one; the drawn off liquid is in another vessel subjected to heat, the second equivalent of carbonic acid thus driven off, freed from steam by cooling, and then used for any suitable purpose. The residual liquid is again a solution of ordinary carbonate, and need only be cooled down to be used again in the absorbing apparatus. I have never put this method to the test, and do not know whether it is cheap enough, but I consider that the impure carbonic acid obtained according to the description in my patent, viz., by the burning of coke in connection with a lime-kiln, with the addition of the gas from boiling down the bicarbonate solution made in the main operation, does well enough for all purposes in my process. It must, of course, be forced into the "converters" by means of an air-pump, and before employment, it must be cooled down and washed the usual way. In any case, it will be quite impossible to absorb anything like the whole of the carbonic acid in one, or even in two converters (I always use two converters, each to be the first in turn), since, as I mentioned before, it is essential for such rapid work as would be necessary on a manufacturing scale to force the gas through the liquid in a strong and quick current. But here comes in a combination of apparatus which I devised for the purpose of completely utilising the carbonic acid. Behind the converters, and at a higher elevation, I place closed vessels, not necessarily provided with agitating shafts, in which I put a solution of barium sulphide obtained in a manner to be described anon. By using two such vessels one after the other, every trace of carbonic acid is taken out of the gas, and replaced by sulphuretted hydrogen, whilst barium carbonate is precipitated. When the whole of the contents of the first vessel has been converted into a milk of water and barium carbonate, the mixture is run out, first into a settling tank, in order to remove a portion of the clear water from the top of a thick mud of barium carbonate, and the latter is then transferred into any "converter" just ready to receive it, in order to serve for the main operation. The levels are arranged to suit this. Of course, the current of gas is then directed so as to pass first through the second vessel with barium sulphide, whilst the first one receives a fresh charge of the same, and serves as a second vessel for the final absorption of carbonic acid, till No. 2 is finished in its turn, and so forth. In the place of close vessels, through the contents of which the gas passes in bubbles and under pressure, it is quite possible to use scrubber-like columns without pressure, and I found them to answer much better for this purpose than for "converters;" but in practice I still prefer the former arrangement, as the initial pressure need not exceed in any case 15 lb. per square inch, which is both easy to attain and very favourable for the reaction. It is quite clear that ultimately we have in the escaping gas no more carbonic acid, but sulphuretted hydrogen mixed principally with nitrogen. I must candidly say that I have always seen the greatest difficulty of my process, and, indeed, almost the only important one, in dealing with the sulphuretted hydrogen in such a state of impurity. I tried, but in vain, Kopp's plan, to burn it with a limited supply of air, so as to produce water and sulphur, knowing beforehand that to try burning it completely for the manufacture of sulphuric acid would be useless. I further proposed to absorb it in "purifiers," like those in gas works, by hydrated oxide of iron, say, such as could be obtained from burnt pyrites, or from "purple ore." I also proposed as the most likely plan, to conduct the gas through a mixture of still-liquor and chalk, keeping the latter in sufficient excess to precipitate all manganese, and mixed with water into thin mud; the result would be the re-exchange of carbonic acid for sulphuretted hydrogen, and the formation of manganese sulphide, which might be converted by roasting into sulphate, and then serve instead of fresh still-liquor. In any case manganese or even zinc is for this purpose preferable to iron, since their sulphides are easily converted by calcining into sulphates, whilst iron sulphide could not very well be treated otherwise than by burning the sulphur into sulphurous acid, conducting this into lead chambers, and re-dissolving the residual iron peroxide in hydrochloric or sulphuric acid, clearly not a cheap process. In practice, I found that a mixture of still-liquor and chalk absorbed the sulphuretted hydrogen quite easily; but I never got so far in my experiments as actually to recover from the spent mixture the absorbent again, by drying and calcining the manganese sulphide. This last part of my process is, therefore, merely theoretical, but I really do not think that it presents any serious difficulties. I, of course, did not overlook that the sulphur, in this proposal, is lost, as well as in Leblanc's process; for, on repeating the operation, the chalk will be converted into calcium sulphate, and thus remove the sulphur from the sphere of utilisable products. The mixture of gypsum and manganese sulphate, resulting after calcination, would have to be treated with water, in order to separate the latter from the useless gypsum. There is nothing presenting any difficult aspect in all that; but I must repeat that this method of recovering the absorbent for sulphuretted hydrogen still wants the practical proof I was unable to make of it, and I am fully alive that this detracts a good deal from the value of my process, as the sulphuretted hydrogen evolved is necessarily equivalent to the whole of the alkali produced, and the absorbent, therefore, *must* be recovered, to enable working in a continuous manner. This will be all the more imperatively necessary when the present waste of manganese chloride, in the shape of still-liquor, will have ceased by the introduction of any of the new processes in that branch; but, even as it is, some alkali works produce no still-liquor at all, and not one can possibly produce an equivalent of it to the alkali made, if, as usual, the latter absorbs the bulk of the sodium sulphate manufactured.

I have not mentioned the absorption of the sulphuretted hydrogen by copper solutions, as in Gibb and Gelstharp's method; but this plan is evidently confined to exceptional circumstances. The sulphur is lost as well in this case, and that in the very objectionable shape of sulphurous acid escaping out of the stacks of the copper furnaces.

The last portion of my task is to deal with the baryta compounds involved in the reaction. The barium sulphate precipitated in the "converters" will, in most cases, be too much stained by the traces of iron usually accompanying commerical sulphate of soda, to be sold as "permanent white," which article is required to be perfectly pure; and as its consumption is quite restricted, in any case no large quantity of it could be disposed of. This barium sulphate must, therefore, be re-converted into carbonate, and this can best be done through the intermediate stage of sulphide. The first start would, of course, be made with native heavy spar, and the same material, which is cheap and frequent enough, would also have to make up any losses of baryta, occurring through imperfect reduction,

leakages, &c. Formerly, the reduction of barium sulphate into sulphide used to be considered hardly as a real manufacturing process; the operation was prescribed to be made in crucibles or retorts, and we see that Brunner, like most others, uses in it such an expensive material as resin. I have, however, convinced myself by many operations carried out in a furnace of the size of an ordinary ball-furnace, that the reduction can very easily be performed on the bed of a reverberatory furnace, especially if the oxygen of the air is kept out as much as possible by deep fire-places and tightly-fitting working doors, and that a mixture of baryta and coal dust of a not coking character is thoroughly efficient; the coking, by surrounding the single particles of baryta, impedes a perfect reduction. Of course, frequent stirring is indispensable, and nowhere would a revolving furnace be more in its place than here. I found that in this way upwards of 90 per cent of the baryta could be reduced, but on an average only 80 per cent were obtained. The unreduced barium sulphate is, however, not lost, as it remains behind when the reduced mass is lixiviated and is mixed with a fresh charge. The reduced mass is drawn out into iron barrows, quickly covered over till it cools, and lixiviated with hot water in a closed apparatus, preferably by means of a revolving shaft; and the resulting solution of barium sulphide is used for the production of carbonate by means of the excess of carbonic acid escaping from the "converters," as I have previously described it. As the charge never comes to the melting-point, and the heat required is only moderate, the action upon the furnace-bed is very small, nor is there any sensible loss of baryta by absorption in the same. Probably, some of my hearers will think it rather doubtful, whether this part of my process is practicable on the large scale, but I can assure them that just in that respect I have found no difficulty whatever; the reduction of baryta in reverberatory furnaces is carried out continuously in one or two works on the Continent, for special purposes, and I found the operation much easier than I had myself anticipated.

For the purpose of obtaining a clearer idea of my process as a whole, it may perhaps be desirable to recapitulate its salient features in a few words. Carbonic acid gas, made as rich and as pure as possible, is forced through a series of closed vessels, the first few, or "converters," containing a solution of sodium sulphate and barium carbonate, the next, which I will call "precipitators," standing at a higher elevation, and containing a solution of barium sulphide; the escaping impure sulphuretted hydrogen being dealt with in any of the manners shadowed forth above. The operation produces in the "converters" a precipitate of barium sulphate (which is afterwards reduced to sulphide and charged into the "precipitators") and a solution of sodium bicarbonate (which is boiled down and dried, yielding solid alkali and gaseous carbonic acid). The same operation produces in the "precipitators," by the action of the residual carbonic acid, the conversion of barium sulphide into carbonate, which is run in the state of mud into the converters, and serves for a fresh operation there. It might be suggested that the two operations could possibly be combined into one, avoiding at the same time the lixiviation of barium sulphide, by charging the latter as it comes out of the furnace into a solution of sodium sulphate, and conducting carbonic acid through it; but there are important reasons, which time prevents me to mention, why it is not advisable to do this.

I know I should fail in my duty, if I closed now, leaving my description as it stands, without telling you something about the economical aspect of the process. I will not say much of the plant, since this is a secondary consideration. It would, perhaps, be slightly larger than in ordinary alkali works, but then the repairs would be of a much lighter kind, the furnace work being so different. It is much more important to look at the expense of working. I would not like to say that my process allows a given quantity of sulphate to be worked up as cheaply as Leblanc's process; for the reduction of barium sulphate will cost about as much labour and coals as the balling process. The loss of baryta, however small, has to be made up, and carbonic acid cannot be had for nothing, even by taking it from a lime-kiln worked with coke; the saving of chalk, as against the balling process, would be most likely counterbalanced by a waste of the same in the absorbing process for the sulphuretted hydrogen. Labour, again, would be wanted rather more than for Leblanc's process, but of a cheaper kind, so that there would not be much to choose in that respect. But against these drawbacks you must set the following very important advantages:—Instead of losing 12 to 15 per cent of your alkali, you practically recover it altogether, as I have continually proved in my experiments, and as it is easy to understand; and secondly, what alkali you obtain is chemically pure, except any sodium chloride carried into it by the sulphate employed; but the alkali cannot possibly contain any sulphate, sulphide, or hyposulphite, nor any silica, alumina, or iron, as it is made in the wet way and only dried in a furnace. All you produce has, therefore, the quality of the very best refined alkali, such as is known in the trade as "calcined crystals." If, therefore, as I said just now, my process does not allow to work up a given quantity of sulphate as cheaply as Leblanc's process, on the other hand, the produce obtained is very much larger in quantity, and very much more valuable on account of its purity. In my opinion, which of course you are welcome to criticise to your heart's content, these advantages far outweigh the described and any minor drawbacks, provided that the sulphuretted hydrogen difficulty can be satisfactorily solved. That, in spite of this my opinion, I have had, as yet, no opportunity of practically carrying out my process, is caused by reasons beyond my personal control, and proves nothing either for or against. I have, therefore, thought it only right to make my process somewhat better known by this address, as it may, either as a whole or in part, prove after all a success in hands better able to take it up than I have been myself.

Mr. I. Lowthian Bell proposed, and Mr. Glover seconded, a cordial vote of thanks to Dr. Lunge for his Address, which was duly acknowledged.

NOTICES OF BOOKS.

A Course of Qualitative Chemical Analysis. By W. G. Valentin, F.C.S. London: J. and A. Churchill.

If the number of elementary works on chemistry—systematic as well as analytical—which now issue from the English press is to be taken as a guide, an increasing body of students are giving their attention to this important science, and we ultimately hope to behold a rich harvest of discoveries as the result of their labours.

The work before us commences with a short chapter on chemical operations. The reactions of the elementary bodies, both in the wet and dry way, are then given, each section being followed with appropriate "questions and exercises." We find useful synoptic tables of the behaviour of the groups and sub-groups of elements, and nineteen engravings of apparatus. There are also, for those whose taste inclines in such a direction, "graphic representations" of the constitution of various bodies. The book concludes with an appendix on the preparation and use of reagents; a table showing the solubility of salts in water and acids, and schemes for the systematic examination of simple salts and compound bodies. It will doubtless be fully appreciated by students, though the necessity or the propriety of introducing doubtful hypotheses into a manual of analysis is, to say the least, open to question.

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ON A
NEW AND RAPID PROCESS
FOR THE
GENERATION OF SULPHURETTED HYDROGEN GAS FOR USE AS A REAGENT IN LABORATORY OPERATIONS.*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

SULPHURETTED hydrogen gas is in such constant use in all laboratories that I offer no excuse for submitting a new process for its generation, particularly as there appears to be a positive want for a better one than that at present in ordinary use. Indeed, owing to this want, several processes have lately been published for its preparation especially having for their object a combination of evenness and constancy of delivery, but I have not learnt that the advantages promised by their several authors have been realised in actual practice. In consequence it occurred to me to try whether the reaction of metallic sulphides with zinc in acidified water, described in the third volume of our *Transactions*,† could not be turned to account for the production of this gas. In that paper I stated that an evolution of sulphuretted hydrogen occurred under the above circumstances, the gas being thrown off from the surface of the sulphide used, while the zinc was *oxidised* and the sulphur of the sulphide *hydrised*, a true voltaic pair forming, as further demonstrated in an ensuing article.‡

This reaction, therefore, I applied in the following modified manner, and found it to answer so well that I am induced to make the process public for the benefit of practical chemists:—

Fragments of galena and granulated zinc, in proportions of about 1 to 1, are well mixed and put into a small apparatus of the kind generally in use for the preparation of this gas, and hydrochloric acid diluted with water (1 to 20 or so) poured upon them. Sulphuretted hydrogen is instantly given off, and its evolution is found to proceed energetically, regularly, and continuously for a great length of time—a length proportionate to that of the quantity of material used and its proper adjustment as to parts. A little hydrogen accompanies the gas named, and traces of hydrochloric acid. The acid is, however, easily removed, by allowing it to pass through a little carbonate of lime before use, while the presence of hydrogen can have no bad effect for all ordinary purposes.

After a sufficiency of the gas has been used it is best, in ordinary cases, simply to wash the galena and zinc with water, when the apparatus is ready for further use at a moment's notice; but when quantities are required in rapid succession a form of apparatus may be used which allows the separation of the acid liquid from the undecomposed substances within itself, when the delivery tube is closed. But a still more excellent method may be had recourse to in such cases, and this is to make the necessary electric contact of the zinc with the sulphide dependent upon the juxtaposition of movable wires carried outside the apparatus. For this it is only necessary to use them in mass instead of in fragments, connecting them electrically by means of wires, which are passed through the cork of the apparatus, and which are only allowed contact with each other by means of proper connecting screws.

If care is taken to keep the zinc and sulphide from direct contact, the evolution of gas instantly ceases on disconnecting the wires, and commences on making the connection.

For this last method it is necessary to amalgamate the zinc. I should state that any sulphide which is an electrical conductor may be substituted for galena, such as sulphide of iron or copper, but for cheapness and general convenience I recommend galena. Some kinds of commercial FeS yield HS more readily than others, a circumstance I find generally due to presence of free iron, a voltaic pair being thus presented to the acid (NS).

Having used this method during the last two years a great number of times, I have no hesitation in recommending it as a most simple, expeditious, and enconomical one, easy of control, and capable of delivering the gas equally, continuously, and vigorously; and I am authorised to state that Dr. Hector's experience of it in the Colonial Laboratory testifies to the correctness of these assertions.

* Read before the Wellington Philosophical Society.
† See *Trans: N.Z. Inst.*, vol. iii., p. 222.
‡ *Ibid.* p. 232.

SUPERFICIAL VISCOSITY OF LIQUIDS.

THE idea of a viscosity proper to the surface-layer of liquids was first advanced by Descartés, and has been held by Rumford, Link, Prechtl, Hagen, Nageli, and others: some of whom have thought the property limited to water, while others have considered that all liquids have a greater viscosity in their surface-layer than in their interior.

M. Plateau some time ago made a series of experiments which satisfied him of the existence of superficial viscosity in certain liquids, as water, saline solutions, &c., and solutions of saponin, albumen, and various soaps; while there were others, as alcohol, ether, essence of terebenthine, &c., which had less viscosity at the surface than in the interior.

The principal form of his experiments was as follows:—About the middle of a cylindrical glass capsule was pivoted a magnetic needle. Liquid was poured in till it reached the needle; the latter was then moved 90° out of the magnetic meridian and left to itself; and the time taken by it to return through a certain angle was noted. Next, more liquid was poured in so that the needle was submerged; and its motion was, similarly, observed under these new conditions.

In a recent memoir, M. Marangoni called in question the truth of M. Plateau's inferences. He holds that all liquids have the same viscosity in the superficial layer as in the interior; and considers the resistance to motion on the surface is due, in the case of such liquids as water, which do not give bubbles by insufflation from a wide-mouthed tube, to the capillary action of meniscuses attaching to the needle, and in the case of liquids which give bubbles easily, to the presence of a pellicle of more or less solid nature.

Thus, consider the former case. Suppose concave meniscuses along the sides of the needle, and that the needle moves from left to right, on the surface. Then, on the right, the liquid tends to be raised as it is propelled by the solid, and so the meniscus will become less concave, or even convex. On the left side, again, the solid leaves an empty space and the liquid falls, so that the meniscus becomes more concave than before. And as the attraction of the meniscuses is proportional to their curvature, it follows from the decrease of curvature on one side and increase on the other, that the body is held back retarded.

M. Plateau's reply is, in substance, as follows:—

First of all, this assertion about raising of the liquid and increased volume of the right meniscus might hold good if the needle were partly immersed. But it merely touches the surface; and what it pushes before it is merely the meniscus. Now the friction at the base of

this meniscus, with the subjacent water, generates a resistance which tends to hold back the meniscus, and so, to diminish its volume by causing part of the liquid forming it to pass under the needle; a deduction quite contrary to that by M. Marangoni.

It might perhaps be replied that the solid attracts a body of liquid under it, which acts in the same way as if a portion of the solid were submerged. But if it were so, then in all liquids, and especially in those which have greater viscosity than water, this action should be observable in the motion of a small floating body a little in advance of the needle, before the needle meets it; now in essence of terebinthine, which is much more viscous than water, and in which the needle moves three times more quickly on the surface, no such advance motion is perceived.

No such deformation of the meniscuses has been observed by M. Marangoni. If any considerable changes of the kind occurred, they need not pass undetected. And even supposing the maximum change, it would not be sufficient to account for the resistance which appears.

But further; one proof which was adduced of the superficial viscosity in certain liquids was, that when the needle turned, the whole surface turned with it in the same direction, though more slowly. This could be seen, if lycopodium were sprinkled on the surface. To this fact, M. Marangoni makes reference in his memoir, and states that he will afterwards show it is not inconsistent with his theory. But the only thing connecting itself with this promise appears to be where he says that water sometimes presents a resistant pellicle; that, *e. g.*, well water became covered with a pellicle of calcareous carbonate; that water several times distilled may be exposed six or eight days to the air, without sensible increase of superficial resistance, but that after twelve days, the motion of the needle is twice as slow, and that twenty days later the fine dust of the atmosphere will have formed a pellicle so resistant, that the needle, moved 90° from the magnetic meridian and left to itself, will remain in that position.

But if the rotation of the surface of distilled water be attributed to the presence of a pellicle, what occasion was there to introduce the problematical action of the meniscuses? The pellicle would sufficiently explain the resistance to the needle. On the other hand, what origin is assigned to this pellicle? If atmospheric dust, and it be said that during the earlier days there was not any appreciable pellicle to resist the needle, it was yet of importance to M. Marangoni's theory to ascertain that the surface did not turn with the needle; but this was not done.

Now, in my former experiments with distilled water (says M. Plateau), in which series of ten measurements were made of the time taken by the needle on the surface, there was not apparent the slightest tendency to increasing viscosity. In experiments since made, the time was noted which elapsed from the moment at which the liquid was poured into the capsule till the moment the needle was first left to itself; also the time required in the series of ten measurements. The former was about five minutes, the second about six. Now if a pellicle formed, it could only be from some impurity in the liquid, whether existing in it previously, or arising from contact of water with the metallic parts of the pivot. But in any case the pellicle would have had to form gradually, and, according to the results, it would have had to acquire in five minutes a consistence sufficient to cause rotation of the whole surface along with the needle, and must not have sensibly increased during the six minutes following.

It might perhaps be said that the pellicle existed in the vessel from which the liquid was taken. To remove doubt on this point, a quantity of distilled water, much greater than that needed for the needle experiment, was poured into a large funnel-shaped vessel; the vessel was covered, and allowed to remain thus twenty-four hours, after which a stopcock being opened at the bottom, a portion of the water was allowed to flow (rapidly at first, then slowly) into the capsule till it reached the needle. A little gold dust was sprinkled on the surface, and the needle experiment was immediately made; the whole surface was observed to rotate. The experiment, from opening of the stopcock, only lasted four minutes. Here, it is evident, the water received into the capsule was taken far below the surface of the liquid in the larger vessel, and could contain nothing of the pellicle—if such existed.

Once more, it has been ascertained that the tension of distilled water diminishes rapidly when the liquid is contained in an open vessel; M. Hagen has observed it to descend, in a few hours, from 7·53 to 4·69: consequently, if the resistance to the motion of the needle had for its cause the action of the meniscuses, and if, therefore, the tension of the water played such an important part in the phenomena as M. Marangoni supposes, this physicist should have found a decrease of resistance in the distilled water exposed to air.

The superficial viscosity of water, then, and liquids of the same category, is, according to M. Plateau, sufficiently demonstrated.

Passing next to liquids which allow of being inflated in large bubbles, *i.e.*, solutions of saponin, albumen, and various soaps, M. Marangoni here distinctly applies his theory of pellicles. One of his experiments was as follows:—Having poured into a small capsule a little of a solution of saponin, and using a glass tube 15 m.m. diameter, one end of which was dipped in the liquid, the first bubbles obtained were pretty large, in some cases 10 to 15 centimetres, but those following were successively smaller and smaller; and after fifteen or twenty extractions of the liquid with the tube, it was no longer possible to produce bubbles. These effects, however, he has subsequently admitted, were only got when the solution was highly concentrated.

In another part of his memoir he says:—"If the solution of saponin be poured out after inverting the vessel, so that the superficial portion of the liquid does not escape, one would not obtain even the smallest bubbles."

On this M. Plateau remarks, that he made such an experiment, but with additional precautions. If the thing were done as M. Marangoni indicated, and bubbles were obtained, it might perhaps be said that, as air penetrated while the liquid was flowing out, this air traversed and agitated the mass, and mixed with it more or less of the substance of the pellicle.

Now, the formation of a pellicle in the saponin solution, if such there were, would necessarily be due, either, as M. Marangoni held, to the evaporation of the water, or to the fact that the solution contained a great number of small solid invisible filaments, which gradually rose to the surface and accumulated there.

The funnel-shaped vessel above referred to was filled with a saponin solution, covered, and left at rest for an entire week, that any filaments in the liquid might have time to rise to the surface.

The tube employed for blowing was of glass, and about 20 m.m. diameter. Before using it, the orifice was carefully cleaned with alcohol and distilled water, so that it was readily moistened by the solution (the strength of which was $\frac{1}{100}$.)

The stopcock was quickly opened, and a portion of the liquid withdrawn into a little capsule; there being thus, of course, neither entrance of air nor agitation of the upper part of the mass in the larger vessel.

On immediate trial of the withdrawn liquid, it gave bubbles of the following diameter, successively (in centimetres): 5, 5, 7, 6, 6, 8, 7, 7. The capsule was then emptied and dried, and a new portion of the solution withdrawn. The diameters of bubbles from this were: 6, 4, 4, 6, 6, 8, 9.

Here, then, M. Plateau points out liquid taken from under the surface gives bubbles, and these bubbles cannot be attributed to the presence of a pellicle, there being no time for the evaporation of water necessary, nor for the

rise of any remnant of filaments to the surface. And it would be irrational to argue some mysterious and sudden action of the air; if there were such, it would no doubt continue, and yet, after an exposure of two hours, there is no sensible increase in the diameters of the bubbles.

The tube was, in addition, applied to the surface of the liquid remaining in the larger vessel; and the diameters obtained were: 7, 6, 7, 7, 9, 6. Here there is a slight tendency upwards, which was doubtless owing to some impurity which gradually produced a slight pellicle on the surface.

M. Marangoni says, that if the vessel containing the solution be made to turn on its axis, the superior surface turns with it, while the subjacent liquid remains almost still; the small air bubbles raised on the surface take irregular forms, and if a bubble be blown from the orifice of the tube, and the tube be then left open, the bubble becomes wrinkled, and takes the form of a cone. But all these phenomena, it is replied, can as well be accounted for by a proper superficial viscosity as by a pellicle.

The solution of albumen presents the same phenomena as that of saponin, and therefore the same remarks must apply to it, as also to other liquids of the same category.

As regards a solution of Marseilles soap, M. Marangoni has found that after an hour and a half the time taken by the needle on the surface is nearly decoupled, and that after twenty hours the needle no longer moves. He supposes, therefore, a resistant pellicle to form on the surface, being produced by the action of carbonic acid and air.

This inference M. Plateau disputes. If the needle were not carefully cleaned after each experiment, it might happen that the solution, especially if containing chloride of sodium, would act chemically on it, and thus produce a pellicle of foreign nature, Thus, too, M. Piateau found that with a solution of chloride of calcium the time taken by the needle gradually increased, but when the needle was coated with varnish, this increase was no longer observed. Besides, even supposing the pellicle formed in the soap solution to be independent of chemical action on the needle, M. Plateau would not admit that it is this same pellicle which, with a fresh solution, produced the resistance which he observed to the motion of the needle.

The particulars in the foregoing account are taken from a paper recently communicated by M. Plateau to the Belgian Academy of Sciences. A. B. M.

ON THE MANUFACTURE OF SULPHURIC ACID.

By GEORGE LUNGE.

I do not think it would be right to let Mr. McCulloch's paper "On the Manufacture of Sulphuric Acid," reprinted in your columns these last two weeks, go forth uncommented to the world, as it might thus seem as if the generality of "practical" men on the Tyneside agreed to his views on this important industry, whilst the contrary, in many respects, is undoubtedly the case. I leave other matters to others, and confine myself here to Mr. McCulloch's statements about the respective merits of "steam columns" and "Glover's towers" for denitrating the so-called nitrous acid. I should be very much mistaken if any reader of Mr. McCulloch's paper, previously unacquainted with the facts, could gather from it that the only works of any importance on the Tyne where "steam columns" are used for denitrating is that of Messrs. Allhusen, from which Mr. McCulloch's experience is *exclusively* derived; and that, not only in all other Tyneside works "Glover's towers" are used, but that the *last* acid plant built at Allhusen's likewise contains such towers instead of steam columns. From this fact alone it will be apparent to outsiders that Mr. McCulloch's strong advocacy of steam columns is not shared by any of his colleagues, and, indeed, his objections to "Glover's towers" are mostly very easily refuted. The starting of chambers is just as easy in one case as in the other, by introducing an extra quantity of nitre; and it is just as easy in one case as in the other to provide for the case of laying off the denitrating plant for repairs. As for the nitrogen compounds retained in the sulphuric acid after leaving the denitrating apparatus, there is not much to choose between steam columns and Glover's towers: some manufacturers actually work with less loss in the latter; and at any rate the experience of those who have worked practically according to both systems (which Mr. McCulloch has not done) is, that the consumption of nitre with Glover's towers can be kept at least as low as with steam columns. Mr. McCulloch seems to assume that the only denitrating elements in the former are heat and dilution; but if he did not look down so much upon the "rule of three" as against his cherished "rule of thumb," he would have taken into account the action of the sulphurous acid, which is quite as important, if not more so, than that of heat and dilution in denitrating the acid. Although he does not believe that it is possible to work properly without diluting the acid, I can assure him that, for special purposes, I have done so for many weeks in succession, and am doing so at this moment, with very satisfactory results. The acid is not quite so well denitrated as if it were diluted; but that does not matter very much, as it is used over again in the absorbing column. And I can also emphatically assure Mr. McCulloch and his readers, that if *he* despises the "rule of three" anent the testing of his acids for nitrogen compounds, not only myself, but many of my colleagues, find very great comfort and help in it in the knotty task of keeping sulphuric acid chambers in good working order.

The two principal advantages of Glover's towers, which have caused them to be so generally adopted, are the saving of coals and wear and tear for boiling down, and the avoiding of all loss of acid in that process, all vapours being carried away into the chambers.

I would, however, not close my paper without acknowledging that there are a few valuable hints to acid-makers in the paper, one portion of which I have felt bound to criticise as above.

South Shields, March 24, 1873.

THE SODA PROCESS, AND PROPOSED IMPROVEMENTS.*

By D. HILL.

We have, in the full list of papers just issued, the most gratifying prospect of continued interest in the meetings of the Society. It will be observed that most of the papers to be read are upon some branch of the alkali manufacture or processes akin thereto, and it occurred to me that I might, without trenching on these subjects, give a short sketch of some of the processes which have been suggested from time to time to supersede or radically alter the present soda process.

The processes that have been proposed for this purpose may be arranged in six classes—

In the 1st class we have the processes which obtain, by one simple reaction, either soda or its carbonate from common salt.

The 2nd class embraces attempts to obtain soda from its other natural sources, such as cryolite, felspar, and nitrate of soda.

The 3rd class obtains soda from other salts of soda than the sulphate, or by treating common salt by other acids than the sulphuric.

The 4th class obtains soda from the sulphate in the wet way.

The 5th class contains all those processes which aim at

* From the President's Inaugural Address read before the Tyne Social Chemical Society.

recovering the sulphur of the sulphate, either by balling the sulphate with some metallic oxide, or by treating a solution of sulphide of sodium with a metallic oxide, and the processes which decompose the sulphide by carbonic acid.

The 6th class simply aspires to produce sulphate of soda from common salt in some other way than that at present followed.

It would greatly exceed the limits of an address such as this, to enter into the details of all the processes embraced in these classes. There are nearly fifty distinct processes, and several of them have been improved upon a dozen times by different discoveries. It will suffice to enumerate the chief processes that have been proposed, and where there seem to me points of sufficient interest, to discuss them as briefly as possible.

To obtain soda direct from common salt has always been a tempting field for the chemist. The celebrated Swedish chemist, Scheele, obtained soda by titurating a mixture of litharge and salt with water, and he afterwards used oxide of zinc instead of the litharge. This process, as you are aware, was revived by Bachet in 1869, and he claimed in his patent the improvement of mixing caustic lime with the litharge and salt, so as to obtain an increased quantity of soda from the common salt, and to facilitate the recovery of the litharge. Bachet's process was first submitted to the Jarrow Chemical Company, and after some experiments in their laboratory, it was rejected by them on account of the great consumption of fuel which the process would involve in separating the small quantity of soda from the excess of common salt, and from the known difficulty of separating the last portions of common salt, so as to obtain a marketable caustic soda. This opinion was amply confirmed by the later and more extensive experiments at the Walker Alkali Works. By Scheele's process only about 5 per cent., and by Bachet's process from 8 to 10 per cent. of the soda in the common salt used is converted into caustic.

The valuable papers read by Mr. Clapham at the Newcastle Chemical Society, give some interesting information on the difficulties encountered at the Walker Alkali Works in recovering the litharage from this process.

The decomposition of common salt in solution by carbonate of potash was at one time practised in this country, carbonate of soda and chloride of potassium being obtained, but the low price to which the latter salt has gone since the development of the Stassfurth potash deposits, precludes the possibility of this process being followed again.

Few of the soda processes can claim to have been better investigated, and certainly none have offered more attractions, than the process patented by Dyer and Hemming in 1838, to obtain bicarbonate of soda by treating common salt in solution with bicarbonate of ammonia. It would seem from what was communicated by Hemming to Prof. Brande, and published by him in the fifth edition of his "Chemistry," that these chemists sought to obtain soda-ash and sal-ammoniac by this process, although they indicate at the same time the means they employ to recover the ammonia to react upon fresh portions of common salt. Schlœsing, 1854, Johnson, 1854, Belford, 1855, Schlœsing and Rolland, 1858, Solvay, 1863, and Young, 1872, are some of those who claim to have improved upon this process, most of them claiming to have invented special apparatus for conducting the process. This reaction has the great advantage of being complete, and the only loss of soda sustained is that of the portion which remains as bicarbonate of soda in the solution of chloride of ammonium, which results from the reaction. The complete recovery of the ammonia has been stated to be the chief difficulty in the application of this process hitherto, and certainly any considerable loss of such a valuable substance would tell heavily against the adoption of the process, but it is possible, one would think, to construct apparatus now-a-days with economy which would obviate this, if it was the only difficulty. The point about this process which seems to me of chief interest, is whether the bicarbonate of soda can be obtained sufficiently free from alkaline chlorides to render it capable, by the removal of these hygroscopic substances, to enter the market as bicarbonate. The difference in value of soda as carbonate and bicarbonate is very great; the carbonate containing 52 per cent of soda, and the bicarbonate containing about 38 per cent, are about the same value. The announcement some time since in the "Glasgow Herald" that Mr. James Young had invented a new process for obtaining soda without the agency of sulphur, created a sort of panic in the shares of the Tharsis Company; but on the explanation being given that Mr. Young only claimed to have contrived new apparatus for conducting an old process, the Sulphur Company's shares returned to their propriety. The publication of Mr. Young's specification on this process will be eagerly watched for. Elliot obtained a patent in 1854, for the decomposition of common salt by the bicarbonates of lime and magnesia, of which little is known. The fact that magnesia salts are not precipitated by bicarbonate of soda throws an air of probability over the reverse process.

It was proposed by Sheridan, in 1837, to obtain soda by treating common salt in vapour with highly-heated steam, and later by R. W. Swinburne in 1862, to pass superheated steam over fused common salt, and although this reaction undoubtedly takes place, the extent of it, or the duration of the process necessary to complete it, combined with the difficulty of making apparatus capable of resisting the action of soda at such high temperatures, makes it very doubtful whether such a method will ever attain to a manufacturing process.

Powers and Dale, 1863, have endeavoured to work Swinburne's process by mingling iron with the salt.

Several patents have been taken out to decompose salt by electricity, by Cook in 1851, Watt in 1851, and Stanley in 1853, but until we are better able than at present to convert the latent energy of coal into electricity these processes must belong to the land of dreams. There are three processes mentioned in Richardson's and Watts's "Technology" to decompose salt—by potash, Hagen, 1768; by caustic baryta, Bergmann; and by caustic lime, Cohauson—of which, to say the least, the reactions are doubtful: we know at all events that one of the most convenient ways for obtaining caustic baryta is to treat a solution of chloride of barium with caustic soda.

The processes of the second class have but a limited interest. The decomposition of nitrate of soda by carbonate of potash to obtain saltpetre yields carbonate of soda as a by-product; but this process can only be expected to pay in times of great wars, when saltpetre commands an extravagant price. It is said to have been used during the Crimean War, and afterwards during the American Civil War. An interesting fact regarding nitrate of soda, which I am not aware has been previously published, is that its solutions at a high temperature are converted by metallic zinc into caustic soda and ammonia, with production of hydrated oxide of zinc. If we could readily recover the zinc in the metallic state, this reaction might be utilised in the present high value of ammoniacal salts. The preparation of carbonate of soda is not likely again to be attempted by reducing the nitrate of soda with charcoal. Heard, in 1838, proposed to obtain soda and nitric peroxide from nitrate of soda, by treating it with melted lead.

The preparation of caustic soda from cryolite at one time excited considerable attention, by the treatment of this mineral with lime in boiling mixtures; but its limited occurrence, and the small quantity of soda obtainable from it, put it out of the question as a considerable source of soda. Until the more valuable alkali potash has been economically extracted from felspar, it would be vain to hope for this as a source of soda.

The processes of the third class are all comparatively recent; the oldest probably is that of Samuel, in 1838, who proposes to decompose common salt in the wet way with oxalic acid, and to treat the resulting oxalate of soda with lime to obtain caustic soda; the resulting oxalate of lime

he decomposes by sulphuric acid, and obtains oxalic acid and sulphate of lime. Margueritte employs oxalic acid in the same way, and also proposes to use boracic and phosphoric acids to decompose common salt; and obtains a solution of caustic soda from the borate or phosphate by treatment with lime: to recover the boracic acid he decomposes the borate of lime by carbonic acid, or with hot hydrochloric acid; in the latter case the boracic acid crystallises from the solution on cooling. To recover the phosphoric acid he treats the phosphate of lime with chloride of lead, producing phosphate of lead and chloride of calcium; the phosphate of lead is then treated with hydrochloric acid, resulting from the decomposition of the common salt, and so obtains phosphoric acid for a fresh decomposition of salt, and chloride of lead for treating a fresh portion of phosphate of lime. This process, in fact, professes to decompose salt continuously with the same phosphoric acid and lead, obtaining caustic soda and chloride of calcium as a waste product.

However ingenious these processes are, it must be borne in mind, that however valuable caustic soda may be, it will not do to employ bodies in its preparation which have four or five times the value, such as oxalic and boracic acids, especially as in the processes proposed losses of these bodies must be sustained, and to reduce these losses to a minimum, long and costly processes of separation would require to be followed. If Margueritte's phosphoric acid process is worth anything at all, it seems to me that the most desirable form that it could take at the present day would be to obtain phosphoric acid by means of sulphuric acid from a mineral phosphate, to decompose salt with this acid, treating the resulting phosphate of soda with lime to obtain, as final results of the process, caustic soda and precipitated phosphate of lime; the latter, from its finely divided and highly concentrated state, would command quite as good a market as the same proportion of phosphoric acid in the soluble phosphates of artificial manures. Spilsbury has proposed to obtain caustic soda from tungstate of soda by means of lime, and Newton has proposed to prepare fluosilicate of soda with the view of obtaining caustic soda by treating it with lime.

Sulphate of soda can be partially converted into caustic soda by prolonged boiling with lime.

Two processes have been proposed which strictly belong to this class, but are closely related to the first class of processes. Blanc and Bazille take a mixture of common salt and sand, heat it to redness in an iron cylinder, and pass steam into it at such a rate as will not cool the mixture below a cherry-red heat, and by this means they obtain hydrochloric acid, which is carried away from the cylinder by a pipe as it is produced, and there is left in the cylinder on the completion of the process a neutral silicate of soda which is insoluble in water, so that if any salt should escape decomposition it may be removed by treatment with water, before attempting to render the soda soluble; which is accomplished by heating the silicate to redness in a furnace with two-thirds of its weight of carbonate of soda. By this means a mass is obtained soluble in hot water, which on treatment with carbonic acid gives a solution of carbonate of soda and a gelatinous precipitate of silicic acid. The other process, that of Tilghman, substitutes alumina for the sand in Blanc and Bazilles process; the heating in cylinders and treatment with steam is practically the same; the resulting aluminate of soda was moistened with water and exposed in chambers to the action of carbonic acid, and by treating the product from this operation with water a solution of carbonate of soda was obtained, and the insoluble alumina left behind was capable of use for a fresh treatment of common salt.

These processes attempt to remedy the dangerous effects of soda on the apparatus, at the high heat at which it is separated from common salt by the action of steam, by presenting to it something capable of combining with it at the instant of decomposition, and these bodies have doubtless the additional advantage of keeping the particles of salt asunder, thereby facilitating the action of the steam. Alkali of low strength only has been produced by the latter process when tried on the manufacturing scale.

The fourth class of processes consists for the most part in treating a solution of sulphate of soda by baryta or its carbonates, to obtain caustic soda, or carbonate of soda.

Fuller, in 1819, was the first to suggest the use of caustic baryta for obtaining soda; at that time carbonate of soda was the only saleable form of soda, and he converted the caustic into carbonate by carbonic acid; since that time caustic soda has become one of the principal, and at the same time one of the most valuable, marketable products of an alkali work. The attention which this process has commanded therefore need not be wondered at, or that the preparation of caustic baryta, by some cheap means, from its sulphate should continue to absorb the attention, as it is the dream, of some chemists.

Caustic baryta decomposes sulphate of soda with one equivalent, and has the further advantage of decomposing a solution of any strength, so that liquors can be obtained by it without having to pass through a concentrating process before running into the pans in which the caustic is finished. In this, as in all the processes in which baryta is used, sulphate of baryta is obtained from which the baryta must be recovered, as it is too valuable to waste, and, indeed, one chemist proposes to sell the precipitated sulphate as a white colour instead of the ground mineral sulphate; but no process hitherto suggested can obtain caustic baryta from its sulphate, excepting at a cost greater than that of the whole of the present soda process.

A German chemist, Köbunter, proposed to use carbonate of baryta to decompose a solution of sulphate of soda, but it has been shown that the decomposition is not perfect; when equivalents of carbonate of baryta and sulphate of soda are used, only 75 per cent of the sulphate is decomposed. It has been suggested, to overcome this difficulty of an imperfect reaction, to employ bicarbonate of baryta instead of the simple carbonate, or to force carbonic acid into a mixture of the carbonate with sulphate of soda, and under these circumstances complete decomposition of the sulphate of soda is obtained. I may just mention that when trying the next process in 1865, I tried boiling a mixture of carbonate of baryta with lime, in equivalent proportions, in solution of sulphate of soda under pressure, and obtained a complete decomposition, getting all the soda as caustic without a trace of sulphate: this process does away with the difficulty of obtaining caustic baryta, bnt it is questionable whether the recovery of the carbonate of baryta from the mixture of sulphate of baryta and carbonate of lime would be any cheaper than attempting to recover baryta in the caustic state from the sulphate.

Clausen, in 1852, in one of those sweeping specifications which we occasionally meet with, claims the use of the hydrates of baryta, strontia, and lime, to decompose solutions of sulphate of soda, and heat is said to facilitate the reactions. Singularly enough, lime does decompose a boiling solution of sulphate of soda, but in experiments upon this, I never succeeded in getting more than about 1 per cent of the soda in the sulphate as caustic soda. A. G. Hunter patented an improvement upon this process in 1865. It consisted in heating the mixture of lime and solution of sulphate of soda under pressure, by which he claimed to obtain a better decomposition of the sulphate. Experiments conducted at the Jarrow Chemical Works, showed, however, that the decomposition under these circumstances is still far from complete; with a steam pressure of 40 lbs., only about 6 per cent of the soda was causticised, and even under a pressure of 200 lbs., maintained for some hours, only 13 per cent was obtained as caustic.

The fifth class may be subdivided into three groups.

The first embraces all the processes which have

been suggested to substitute metallic oxides and the other earthy bases for the carbonate of lime in Le Blanc's process. Some of these are of a very early date: furnacing sulphate and coal with lead, tin, or iron was proposed by Higgins in 1781; oxides of manganese, zinc, and copper, as well as the carbonates of baryta and magnesia, have been proposed in later times. The processes of this sort which have been proposed in recent years have aimed at the recovery of the sulphur from the metallic sulphide obtained in the balling process, such as Blythe and Kopp's process of 1854, which was tried a few years ago at one of the Tyne works, only to be abandoned. There is said to be great difficulty in lixiviating the balls from this process, and some tendency to form an insoluble sulphide of iron and sodium. At one time it was a favourite idea to utilise the burnt pyrites from the sulphuric acid process in this way; but, since the introduction of the Spanish and Norwegian cupreous pyrites, oxide of iron is no longer a waste product, the development of the copper-extracting process having found a use for the oxide of iron as a substitute for hæmatite in the puddling process.

With the exception of manganese, the other metals proposed to be substituted are too costly, such as tin, lead, zinc, and copper, and besides they do not present the facility of recovery that iron does, they part less freely with their sulphur, more especially if they get oxidised to sulphate in the process of burning off. Reinar proposed to use the native carbonate of baryta, witherite, in place of carbonate of lime: it is said to have given unsatisfactory results. Hofmann, in his celebrated "Exhibition Report," remarks, about this process, "that it is difficult to see any advantage in substituting, for carbonate of lime, a substance the atomic weight of which is more than three times as great." He appears to be thinking of the atomic weights of calcium and barium when he wrote this, the atomic weight of the carbonate of baryta being scarcely twice that of the carbonate of lime.

Clemm's process, using magnesia or its sulphate instead or carbonate of lime, occupies the border land between the groups of this class. He reduces his mixture in a furnace, casts the product into cylindrical masses, consisting of sulphide of sodium and caustic magnesia. He moistens these, and places them in an atmosphere of carbonic acid, until the magnesia is converted almost into bicarbonate, when he withdraws the cylinders, now consisting of sulphide of sodium and bicarbonate of magnesia, heats them in a stove to about 500°, at which point the bicarbonate of magnesia is entirely decomposed; the carbonic acid at the same time disengaging sulphuretted hydrogen from the sulphide of sodium, so that there is obtained a mixture of carbonate of soda and magnesia, from which the carbonate may be extracted by water. The sulphuretted hydrogen he proposes to convert into sulphuric acid in the ordinary chambers, or to obtain sulphur from it by treatment with sulphurous acid gas and steam.

One of the most interesting features of his process is the means he employs to obtain pure carbonic acid. He passes furnace gases over moistened magnesia, preferably that which has been calcined with soda, which is said to be more active, until the magnesia is for the most part converted into bicarbonate, when he heats the vessel containing it to 500°, which suffices to drive off all the carbonic acid. Clemm's process can, however, have only a local interest for the Stassfurth mines, where so many curious double salts of magnesia and soda are obtained.

The second group of the class contains the processes which prepare sulphide of sodium, with the view of treating its solution with metallic oxides or their carbonates, to obtain a solution of caustic soda or carbonate of soda. It appears to be the general experience of those who have tried to make sulphide of sodium on the large scale, that the product is always more or less contaminated with carbonate of soda; and indeed one of the earliest processes proposed for obtaining carbonate of soda consisted in alternately reducing sulphate and oxidising the sulphide until a considerable quantity of carbonate was formed. The occurrence of this carbonate must therefore operate as a bar to obtaining a strong caustic soda from a solution of the sulphide, by simple treatment with a metallic oxide. The only oxides capable of converting sulphide of sodium into caustic soda, with single equivalents, are the oxides of zinc, lead, and copper; and as the equivalent of zinc is less than a third that of lead, and its price about a third that of copper, it seems to me the only oxide that could be employed in this way. Its use was patented by Hunt in 1840, and its use and very ingenious means for its recovery in connection with the removal of sulphides from ordinary tank liquors, so as to enable caustic soda of the highest marketable strengths to be produced direct from that source, has recently been patented by Parnell. Hunt proposed to obtain sulphate of zinc from the sulphide, and to decompose common salt with it; and I suppose he contemplated the recovery of the oxide by treating the chloride of zinc with lime. The oxides and carbonates of iron and manganese do not decompose the sulphide in equivalent proportions,—an excess has always to be used. In trying to remove the small quantities of sulphide of sodium in tank liquor by carbonate of manganese, I found it necessary to use from ten to twelve equivalents for one of sulphide of sodium.

The treatment of sulphide of sodium by carbonic acid has called forth the utmost ingenuity in contriving apparatus for conducting the process, and in the invention of means to get sulphuric acid or sulphur out of the sulphuretted hydrogen. At the first glance the process appears very attractive; it dispenses with the use of chalk or limestone, does away with tank waste, and offers the inducement of sulphur recovery. But if the sulphuretted hydrogen requires to be converted into sulphuric acid, you require to treat the sulphide with pure carbonic acid, which could not in any case be obtained at the cost of the chalk saved. Great difficulties have been found by those who have tried to convert the sulphuretted hydrogen into sulphuric acid, in obtaining or supplying to the chambers this gas at an equal rate; and for some cause or other there seems to be a difficulty in converting the burnt gas into sulphuric acid in the chambers. The other course open is to use carbonic acid, produced by burning coke in contact with limestone, and get the sulphuretted hydrogen mixed with from 70 to 80 per cent of nitrogen, a state in which it is only fit to be treated by sulphurous acid and steam to obtain sulphur, or to pass over oxide of iron in something like the style of gas purification, or as it has been applied by Gibbs and Gelstharp to precipitate copper. All have failed in making sulphuric acid direct from the sulphuretted hydrogen; the preparation of sulphur has apparently been as hard to deal with; and the roundabout course of absorbing sulphuretted hydrogen by oxide of iron yields a product low in percentage of sulphur, from which the manufacture of sulphuric acid is expensive. The application of this gas to the precipitation of copper from solutions of the sulphate, thus obtaining a dilute sulphuric acid, and the oxidation of the sulphide of copper to the state of sulphate and re-precipitating appear to be of very doubtful value. The cost of fuel for the evaporation of the dilute acid and for furnacing the sulphide of copper would go a long way to pay for the sulphur necessary to make acid from fresh pyrites. The recovery of the sulphur does not present the same inducements in value, now that the use of pyrites has become universal; and it appears to me, that to make the soda process subservient to the recovery of sulphur is unsound in principle; first of all make soda, and then recover the sulphur if it appears worth while: and the best process to my mind is that which yields the sulphur as such. It cannot of course be considered that attempts to obtain caustic soda from the sulphide are anything else than direct soda

processes, the sulphur would be recovered without interfering with the soda process.

There are very few processes in the sixth class which have any interest at the present day; a good many have been proposed to obtain sulphate of soda by double decomposition of common salt with other sulphates. The only processes of this sort worth mentioning here are the decomposition of salt by means of the native sulphates of magnesia and lime, first proposed by Wilson in 1838. The decomposition with sulphate of magnesia may be accomplished by allowing boiling solutions of the salts to cool to near the freezing-point, when nearly all the sulphate of soda crystallises, leaving chloride of magnesium in solution. The sulphate of lime requires to be converted into sulphate of magnesia through the instrumentality of carbonate of magnesia, and the sulphate of magnesia afterwards treated with common salt. These processes have a special interest in consequence of the immense deposits of kieserite and double sulphates of magnesia and soda in the Stassfurth Mines. The process, known as Longmaid's, for obtaining sulphate of soda by roasting pyrites with salt, was known 50 years before the date of his patent in 1842, and is said to have been practised in France at that time. The decomposition of the salt has never been obtained complete by it unless the pyrites is considerably in excess of that required by theory. In 1853, Robb proposed to obtain sulphate by passing sulphurous acid, air, and steam, over a mixture of common salt and oxide of iron. Brooman, in 1857, dispensed with the oxide of iron, and passed the gases over common salt contained in hot flues; and Hargreaves, in 1872, mixes the common salt with sufficient water, and moulds it into bricks, for treatment with sulphurous acid, air, and steam, in hot chambers, The tediousness of the converting process, and the inevitable loss of a considerable quantity of sulphurous gas, are obstacles at present to the application of this process; it is however a most interesting one, and seems to have been gradually developing since Longmaid's time.

I would have liked to have gone into some of these processes more fully, and especially those in which the reactions are of an imperfect or limited character, as the study of the conditions under which they take place and the conditions which modify the results obtained are of great interest to the chemist, but fearing to be tedious I have left out much that I might have said on this score, and perhaps this may form the substance of a future paper on limited reactions.

METALLURGICAL SCIENCE.*

It is with a feeling somewhat akin to shame that we are bound to acknowledge the poverty of our language in metallurgical literature. The entire catalogue of English works on metallurgy may be told off in two minutes upon one's fingers, and several even of these are at present too rare to be generally accessible, or too antiquated to be practically useful. Percy's masterly work, though commenced more than a dozen years ago, is at present nothing more than a splendid fragment; while two out of the three volumes which have been issued are already out of print. Phillips's Manual, excellent in its day, is well nigh useless at the present time; and the same remark applies with even greater force to several other works which were at one time standards of reference. It is true that we can boast of several capital volumes on special branches of metallurgy—Phillips's "Gold and Silver," to wit; but the fact remains that we can point to only a single modern treatise which comprehensively treats of the entire range of metallurgical operations: that treatise we need hardly say is the recent adaptation of Kerl's celebrated "Handbuch."† But these three handsome volumes, though not a whit too bulky for the matter they contain, are appalling to the student who does not wish to dip deep into the subject; and it must therefore be confessed that a trustworthy moderate-sized text-book of home growth has long been a real want to the student. Mr. Makins has sought to supply this want, and though his "Manual" is a long way from satisfying us, there is no doubt that for its size, it is the best that we at present possess.

As those who are familiar with the former edition of this work may have been led to view it somewhat unfavourably, it is only fair to mention at the outset that the present edition has been re-written, considerably enlarged, and in every way improved. The modern atomic weights are employed throughout, the chemical nomenclature is quite up to date, not to say a little pedantic in a practical book, and degrees of temperature are expressed on both the Fahrenheit and Centigrade scales. The arrangement followed in the classification and description of the metals is to our notion somewhat fanciful. The so-called "noble metals," mercury, silver, gold, platinum, and palladium, are taken first; and the "base metals" are then dealt with in the following order:—Lead, bismuth, copper, antimony, uranium, titanium, chromium, arsenic, iron and steel, manganese, cobalt, nickel, tin, zinc, cadmium, aluminium, magnesium, potassium, and sodium. It also occurs to us that the space is very disproportionately distributed among these metals; for example, silver occupies 70 pages, and gold takes exactly the same space, whilst copper, in spite of its high importance and the complexity of its metallurgical treatment, receives only 32 pages, and iron and steel *together* are condensed into 65 pages.

It is pleasing to note that, in many parts of his work, Mr. Makins shows himself to be fairly abreast of his subject. He offers us, for example, fair descriptions of Miller's process for toughening brittle gold by means of chlorine; of Siemens's regenerative furnaces, his method of steel-making, and his electrical pyrometer. On the other hand, we may light upon parts of the book which are certainly behind the day. Nowhere is this more conspicuous than in the chapter on iron and steel. Here we look in vain for any notice of Mr. Lowthian Bell's important researches on the blast-furnace, though surely these researches must be known to anyone who is writing on the theory of iron smelting. But it is yet more curious that in a work published in 1873, with an appendix, too, for the latest novelties, there is no mention of Danks's rotatory furnace, or, indeed, of any furnace for mechanical puddling. It is scarcely too bold to say that the days of manual puddling are numbered, and one of the most interesting problems at present engaging the attention of the ironmaster is the best means of substituting machinery for this exhausting and time-consuming labour.

Comparing one part of Mr. Makins's book with another, it is clear that the most satisfactory chapters are those on silver and gold; and, as might be expected from the author's former position, we find him at his best when describing the methods of assaying these two metals.

In a hasty perusal of this "Manual," we have stumbled on a considerable number of errors. It may be charitable to father some of these upon the printer, but others are of a graver character, and clearly betray the unpleasant fact that the author is not always master of his subject. At the same time, we willingly admit that the book has merits which are neither few nor small, and we repeat that, in the present state of our metallurgical literature, we know of no handier manual than that of Mr. Makins's. Every page may not smell of the furnace, but the volume as a whole is evidently the work of an honest and painstaking compiler.

* "A Manual of Metallurgy." By George Hogarth Makins, M.R.C.S., F.C.S., &c. Second edition; re-written and much enlarged. London: Ellis and White. 1873.

† "A Practical Treatise on Metallurgy." Adapted from the last German edition of Professor Kerl's "Metallurgy." London: Longmans and Co.

CORRESPONDENCE.

MANUFACTURE OF CHLORINE.

To the Editor of the Chemical News.

Sir,—With reference to a passage in my Inaugural Address, reprinted in your last issue, Mr. Walter Weldon requests me to state that now more than half the chlorine made in Great Britain is made by his process, and that nearly a score new plants are in course of construction.

I gladly comply with Mr. Weldon's request, although I am sure that the whole context of the passage in question totally excludes the idea of any disparagement being meant to the processes referred to.—I am, &c.,

George Lunge.

MISCELLANEOUS.

London International Exhibition, 1873.—A meeting of the Sub-Committees on Surgical Instruments and Appliances was held in the West Theatre, Royal Albert Hall, on Monday, the 24th ult. The following members were present:—Sir Wm. Fergusson, Bart., F.R.S.; Mr. W. White Cooper; Mr. H. J. Domville, C.B., M.D.; Mr. J. Hilton, F.R.S.; Mr. R. Liebreich; Prof. J. Marshall, F.R.S.; Mr. A. E. Mackay, M.D.; Mr. T. W. Nunn; Dr. W. S. Playfair. The committees inspected the various objects which have been submitted on exhibition.

Preserving Charred Papers.—Mr. E. H. Hoskins, of Lowell, Mass., has suggested a very useful and practical way of preserving and giving toughness and flexibility to charred paper, which has proved to be of much importance in the identification and copying of valuable documents, charred by conflagrations such as the recent Boston and Chicago calamities. We have seen specimens of charred papers and bank-notes, thus treated, that can be handled with impunity. The printing upon the charred bank-notes can be readily discerned. The preserving process consists, we believe, in pouring collodion upon the surface of the charred paper. The collodion forms a thin transparent film, dries in a few minutes, when the process is complete.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 24, 1873.

In addition to a large number of original papers and memoirs relating to various other branches of the exact sciences, this number contains the following original papers and essays relating to chemistry:—

Constitution of the Hydracids when in Solution, and on the Inverse Reactions which they call forth.—Dr. Berthelot.—This essay is the continuation of that alluded to in the preceding number of this periodical. In this portion the author records his extensive investigation on the constitution of the hydracids dissolved in water. These solutions differ greatly; in the more dilute solutions various hydrates are present, while in the concentrated solutions, hydrates with 1 equivalent of acid, and even anhydrous acid, are present. There appears to be a marked difference between the chemical properties of the anhydrous acids and their hydrates, while the thermical properties also vary.

Researches on New Derivatives of Propyl.—A. Cahours.—This exhaustive monograph, elucidated by a large number of formulæ, treats on the organo-metallic alcohol compounds of the propyl series, and more particularly on the zinc, aluminium, and arsenic combinations with the organic bodies alluded to.

Thermo-Chemical Researches on the Measurement of the Chemical Action of the Sun's Rays.—E. Marchaud.

Volumetrical Estimation of Carbonic Acid.—A. Houzeau.—The author briefly describes a process consisting first in the absorption of the carbonic acid by a solution of caustic soda, whereto oxide of zinc is added. Next, to the carbonate thus produced chloride of barium is added, and the soda—not previously combined with carbonic acid—is estimated volumetrically by titrated sulphuric acid.

Researches on Trichloracetic Acid and Trichloracetates.—A. Clermont.—This paper treats mainly on the trichloracetates of mercury, and is elucidated by a large number of formulæ and results of analyses.

Researches on the Ripening of Fruit and on Endosmose of Leaves and Roots of Plants.—J. Boussingault.—An exhaustive phyto-chemical essay.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 4, 1873.

Contains the following original papers and memoirs:—

Selenic Acid and Selenates.—Dr. von Gerichten.—The selenic acid is best prepared by first oxidising the selenium with nitric acid and converting it into selenious acid. Potassa is next added to the solution and chlorine passed through it so as to obtain selenic acid; the product is then combined with baryta. By double decomposition the salt thus formed is, with the aid of a slight excess of carbonate of potassa, converted into a selenate of the last-named base. The mixture of (for, as pointed out by H. Rose, see Fresenius *Zeitsch*, vol. i., 73, the decomposition alluded to is not quite complete) carbonate and selenate of potassa is, in order to neutralise the former, treated first with nitric acid, and next with a soluble lead salt, the selenate of lead is lastly decomposed by sulphuretted hydrogen. The selenates are, it is well known, generally isomorphous with the sulphates, chromates, and manganates. This paper also treats on the composition of the double alums of selenic and sulphuric acid, and is accompanied with a series of lengthy and complex formulæ, of which the following is quoted as an instance:—

$$\begin{array}{l} SO_2\begin{array}{l} \diagup O \\ \diagdown O \end{array} \\ SeO_2\begin{array}{l} \diagup O \\ \diagdown O \end{array} \end{array} \begin{array}{l} \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} Al.Cr \\ \} K.NH_4 \end{array} + 12H_2O$$

Chemical Composition of the Eggs of Serpents.—Dr. Hilger.—The eggs of the *Coluber natrix*, an indigenous reptile of Central Europe, were investigated by the author. The shell contains carbonate and phosphate of lime, and traces of silica, iron, and sulphate of lime. (The author observes that this compound is more frequently met with as a constituent of the bodies of the lower orders of the animal kingdom, such as the skin of a Holothuria species, and also the tunica of *Pyrosoma ind.*, &c.) The yolk of the eggs contains an albumenoid matter akin to myosin; further, lecithin, cholesterine, alkali-albuminate, ordinary albumen; and as mineral matter, phosphates, chlorides and sulphates of alkalies. In addition to these substances the yolk as well as the shell was found to contain a peculiar organic matter, rich in nitrogen, but quite free from sulphur and phosphorus. This organic matter in the dry state is a yellowish horny mass, which swells up in water, and is insoluble in alcohol, ether, acetic and dilute hydrochloric acids, while it resists the action of concentrated caustic potassa for several months. Its percentical composition is—Carbon, 54·68; hydrogen, 7·24; nitrogen, 16·37; oxygen, 21·10. These figures closely resemble the composition of elastin, but the author intends to investigate this subject further.

On Phenanthren and Anthracen.—R. Fittig.—The contents of this paper, elucidated by a large number of complex formulæ, treat more particularly on the keton formation from anthracen and phenanthren.

Researches on Phenols.—H. Hübner and O. Brenker.—This monograph is divided into the following sections:—Preparation of monobromphenol, C_6H_4BrOH, from β-bromsalicylic acid by dry distillation; preparation of monobromphenol from crystallised phenol and bromine; preparation of chloro-salicylic acid, $C_6H_3ClOHCOOH$, by the action of chlorine upon salicylic acid.

Conversion of Benzoic into Metachlororthoxy-benzoic Acid.—H. Hübner and G. Weiss.—7 grms. of benzoic acid, 4 grms. of manganese (peroxide, previously washed with hydrochloric acid), 40 grms. of concentrated hydrochloric acid are heated to 150° in a sealed glass tube, and after a repeated re-crystallisation of the contents, there is obtained pure metachlor-benzoic acid, the baryta salt of which,—

$$(C_6H_3.Cl.H.COO)_2Ba,$$

crystallises in long needle-shaped crystals. By treating the acid with fuming nitric acid there is formed metachlorortho-nitrobenzoic acid, $C_6H_3.Cl.NO_2.COOH$. This body, on being treated with tin and hydrochloric acid, yields metachlorortho-amidobenzoic acid—

$$C_6H_3.Cl.NH_2.COOH.$$

a crystalline amido acid fusing at 148°. The metachlorortho-benzoic acid is formed by the previously-mentioned acid being treated at 50°, and dispersed through water with nitrous acid.

Action of Benzoic Acid on Phenyl-Mustard Oil (Phenyl-senföl).—S. M. Losanitch.

Some Iodine Substitution Products.—P. Weselsky.

Formation and Decomposition of Ketons.—W. Staedel.

A New Species of Lime-Precipitating Plant.—F. Wibel and Zacharias.—This paper treats mainly on the peculiar property of a potamogeton species of separating lime from water in which it is dissolved.

Pseudomorphoses of Glass and Gypsum due to the Action of Cranberries.—F. Wibel.—It appears that the sample of the fruit alluded to had been kept in a glass bottle for some time, and the acid (chiefly malic) contained in the berries had decomposed the soda-glass, thereby giving rise to the formation of a compound which, on analysis, was found to contain—Water, 4·96 per cent; organic matter, 5·29; gypsum, 56·83; glass, 32·92; total, 100·00.

Analysis of Waters from the Ionian Islands.—F. Wibel.—From among the large number of results of analyses here quoted, we mention the more interesting:—Cape Hugios Georgios (St. George), Peninsuly Lexuri; sp. gr. of the water 1029·78; constituents in 1 litre—Chloride of sodium 31·68, sulphate of lime 1·96, sulphate of magnesia 2·09, chloride of magnesium 3·43. Water from Argostoli; sp. gr. 1023·96; chloride of sodium 32·22, gypsum 1·77, sulphate of magnesia 2·33, chlormagnesium 3·75. The other waters are either brackish or fresh water, but their composition is chiefly of local interest.

Fibrous Quartz of South Africa.—F. Wibel.—After first refering to Klaproth's researches (1815) on this subject, the author quotes the following results of analysis:—Brown-coloured fibrous quartz, sp. gr. at 15°=3·05; composition—SiO_2, 57·46; Fe_2O_3, 37·56; H_2O, 5·15. Blue-coloured fibrous quartz, sp. gr. at 15°=2·69; composition—SiO_2, 97·27; FeO, 1·67; CaO, 0·15; Na_2O, 0·15; H_2O, 0·76.

New Hydrocarbon Obtained from Diphenyl-keton.—R. Fittig.

On Graphite.—C. Rammelsberg.—The main contents of this lecture, elucidated by the exhibition of specimens, may be summarised as follows:—History of graphite in its geologico-geognostic bearing; loss by ignition, amounting in the following samples—Ticonderonga (N.Y.), 3·85 per cent; Ceylon, 2·56; Borrowdale, 3·8 to 5·08; Upper Jenisei (Siberia), 2·53; Tunguska (Sidorow), 1·77 to 2·38. The quantity of earthy matter in these samples is respectively—Ceylon, 1·28 per cent; Borrowdale, 7·0; Upper Jenisei, 4·5; Tunguska, 6·53. Comparison between the combustibility of graphite and diamond, as well as other amorphous carbon species. Some kinds of graphite burn completely off, others do not, when in contact with fused saltpetre; among the former the author quotes—Ceylon, sp. gr. 2·257; Borrowdale, 2·286; Upper Jenisei, 2·275; Upernivik, (Greenland), 2·298; Arendal, 2·321. To the non-burning off belong—Ticonderonga, sp. gr. 2·17; Ceylon (other sample marked II.), 2·246; blast-furnace graphite, 2·30.

Preliminary Notice on the Decomposition of the Ketons.—Dr. W. Haedel.

On Lead; the Impurities it may Contain, and the Influence thereof upon the Industrial Applications of this Metal.—G. Brigel. Reserved for translation.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

650. M. Henry, Fleet Street, London, "Improvements in the mode of, and apparatus for, treating marine plants, called sea-weed, sea-wrack, and algæ, in order to obtain useful products therefrom for industrial and other purposes."—A communication from the Société Collett et de Lavillase, Landernau, France.—Petition recorded February 20, 1873.

752. J. Buchanan, Hebburn, Durham, "Improvements in utilising alkali waste in the manufacture or production of building materials."—Petition recorded March 1, 1873.

809. L. O. Durruthy and H. P. Lissagarary, Rue des Petits Hotels, Paris, "Improvements in the treatment of blood for the manufacture of manure."

819. A. P. Vassard, New Cross, Kent, "Improvements in the manufacture of artificial fuel, and in the solidifying of coal-dust and other substances by agglomeration."—Petitions recorded March 6, 1873.

823. W. Wright, Sheffield, Yorkshire, "Improvements in the manufacture of gas for heating and illuminating purposes, and in apparatus for the same, parts of which are applicable to other purposes."—Petition recorded March 7, 1873.

834. J. Keene, Bush Lane, Cannon Street, London, "A new or improved amalgam for the better imitation of silver."—A communication from Madame P. Baudoin, Rue des Marais, Paris.

841. J. Wadsworth, Manchester, "Improvements in utilising refuse matter for the manufacture of fuel and manure."

847. F. Kuhlmann, Paris, "New utilisations of the acid residues resulting from the manufacture of chlorine."—Petitions recorded March 8, 1873.

854. E. Galeer, Bienne, Berne, Switzerland, "An improved hair-wash."—Petition recorded March 10, 1873.

863. H. Page, Mincing Lane, London, "Improvements in the manufacture of paper-pulp or half-stuff."

868. W. Weldon, Putney, Surrey, "Improvements relating to the manufacture of chlorine by means of compounds of manganese regenerated in the wet way."—Petition recorded March 11, 1873.

891. J. Jones, Great Lever, Lancashire "Improved combinations of substances or materials to be used as a substitute for coal for obtaining heat and light, and in the arrangement of the furnaces or fire-places connected therewith."

894. R. J. Jones, Walton, near Liverpool, "Improvements in operations and apparatus for drying-down waste alkaline solutions of extractive matter obtained in preparing vegetable fibrous material for use in the manufacture of paper, and in recovering therefrom the alkali for re-use, also for utilising the vapours given off during the boiling of the vegetable material or the drying-down of the said solutions."

896. S. B. Darwin, Shrewsbury, Salop, "Improvements in the means of manufacturing gas."—Petitions recorded March 12, 1873.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

980. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of cheese."—A communication from H. O. Freeman, Sherburne, New York, U.S.A.—Petition recorded March 17, 1873.

NOTICES TO PROCEED.

3278. W. Glazier, Rochdale, Lancashire, "Improvements in treating and utilising certain refuse animal and vegetable substances, and the application of the resulting substances or matters to various manufactures."—Petition recorded November 5, 1872.

3288. H. Harrison, Killenaule, Tipperary, Ireland, "Improvements in the manufacture of artificial or prepared fuel from anthracite dust o 'culm,' or from other coal dust, and in apparatus employed in such manufacture.—Petition recorded November 6, 1872.

3300. G. H. C. Hedley, W. Smith, and T. A. Hedley, Salisbury Street, Strand, London, "Improvements in the manufacture and purification of gas, and in the apparatus employed therein and connected therewith."—Petition recorded November 7, 1872.

3335. C. de Sainte Marie, Porte Ste. Marie, France, "An improved process of tanning hides and skins."—Petition recorded November 9, 1872.

3460. A. Morgan, South Lambeth Road, Surrey, "An improved method for purifying and amalgamating gum resins, including Kauri gum."—Petition recorded November 20, 1872.

645. J. Webster, Birmingham, "Improvements in applying gases or vapour to the refining and purifying of metals, and in apparatus to be employed for that purpose."—Petition recorded February 20, 1873.

736. R. Jukes, Sheffield, Yorkshire, "Certain improvements in the construction of reverberating-furnaces or cupolas, and in the processes connected therewith for the purpose of smelting."—Petition recorded February 27, 1873.

803. W. Mickle, Tynemouth, Northumberland, "Improvements in smelting and puddling iron."—Petition recorded March 5, 1873.

PATENTS SEALED.

2822. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in the reclamation of materials employed in the manufacture of diphosphate and triphosphate of lime."—Dated September 24, 1872.

3014. S. H. Johnson, F.C.S., Stratford, Essex, "Improvements in the method of, and apparatus for, separating the soluble constituents of substances from the insoluble constituents."—Dated October 12, 1872.

3067. W. Morgan-Brown, Southampton Buildings, London, "An improved composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables."—A communication from F. O. Möller, Rue Lavoisier, Paris."—Dated October 17, 1872.

3505. R. F. L. Jenner, Kidwelly, South Wales, "Improvements in the manufacture of dinas fire-bricks."—Dated November 23, 1872.

3737. W. R. Lake, Southampton Buildings, London, "An improved method of clarifying and settling varnishes, oils, and other like substances."—A communication from F. Kersting, Grand Rapids, Mich., U.S.A.—Dated December 9, 1872.

3924. W. McAdam, Glasgow, N.B., "Improvements in utilising waste-products of chemical and other works in order to render the same applicable for building and structural purposes."—Dated December 27, 1872.

3970. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "New or improved methods, processes, and apparatus for depositing upon wrought-iron, steel, and cast-iron, layers of copper or alloys of copper."—A communication from O. Gauduin, J. B. J. Mignon, and S. H. Ronart, Paris.—Dated December 31, 1872.

213. G. Haseltine, LL.D., Southampton Buildings, London, "Improvements in the manufacture of white-lead, and in the purification of carbonic acid gas used in the said manufacture, and in apparatus therefor."—A communication from A. P. Meylert, New Britain, Conn., U.S.A.—Dated January 18, 1873.

268. H. Williams, Wigan, Lancashire, "Improvements in the utilisation of the waste heat from coke ovens for the manufacture of soda-ash, caustic soda, and for other similar purposes."

273. R. Pitt, Bath, and S. F. Cox, Bristol, "Improvements in the manufacture of leather, and in apparatus for that purpose."—Dated January 23, 1873.

331. B. Latham, Victoria Street, Westminster, "Improvements in purifying sewage, and treating products obtained therefrom for the production of manure."—Dated January 28, 1873.

NOTES AND QUERIES.

Tin Ore.—Is there any shorter and easier analytical test for tin ore than that given in Fresenius?—J. W.

Bichromate of Zinc.—Can any of your readers inform me how bichromate of zinc is made? I imagine, from the few experiments I have made, that it must be a somewhat tedious process.—A Subscriber.

Sesqui-Acetate of Ammonia.—Will your readers inform me as to the best method of making sesqui-acetate of alumina (commercial red liquor) from acetate of lime liquor, stating proportionate quantities and strengths of decomposing bodies?—H. T. C.

Sulphate of Ammonia.—Can you, or any of your subscribers, inform me, through your journal, the quantity of sulphate of ammonia that can be made from a gallon of gas liquor for each degree of sp. gr. by Twaddell's hydrometer?—C. H. N.

Ponceau.—(Reply to S. and H.)—Consult the work of Girard and De Laire, lately reviewed in these columns.

Bunsen Burner.—(Reply to E. R.)—There is no such formula. The matter is easily solved by a good and steady pressure of gas: but in many localities, in as well as out of the Metropolis, the pressure of the gas as usually supplied is far too weak for the purpose.

Ammonium Sulphate.—(Reply to W. B. Giles.)—Concentrate over an open fire in a shallow leaden pan supported by iron, and run the very concentrated fluid off in shallow wooden tanks lined with lead. On cooling, the sulphate will crystallise. Run off the mother-liquor, and again saturate this with ammonia. Of course, on boiling down, some of the latter is volatilised, and an acid liquid results. Try the proper degree of concentration, by taking a sample and cooling it; if it yields crystals, or at any rate a solid saline deposit, run off the fluid into the coolers.—A. T.

"Acoustic Repulsion and Attraction," by R. H. Schellbach, *Phil. Mag.*, 1871, vol. xli., p. 418:—

"If the action exerted upon one another by atoms at exceedingly small distances be admitted as comprehensible, we must be prepared to admit the extension of the attractive or repulsive force to masses at very great distances from one another. The distant action of magnetism and electricity would then require no special explanation, and is not necessarily a consequence of the interposition of a connecting medium. Nevertheless it is possible that phenomena of attraction or repulsion at considerable distances might be occasioned by oscillations of æther or air."

P. 422.—"The sonorous vibrations of an elastic medium attract specifically heavier bodies to the centre of disturbance, and repel specifically lighter ones."

"Approach Caused by Vibration," by Sir W. Thomson, *Phil. Mag.*, 1871, vol. xli., p. 423:—

"The average pressure at any point of an incompressible frictionless fluid originally at rest, but set in motion and kept in motion by solids moving to and fro, or whirling round in any manner, through a finite space of it, is equal to a constant diminished by the product of the density into half the square of the velocity."

P. 426.—"The repulsion of a hydrogen balloon observed by Schellbach is temptingly suggestive of the conclusion he has drawn, that there is attraction or repulsion accordingly as the density of the interior gas is greater or less than that of the surroundingair."

MEETINGS FOR THE WEEK.

Monday, April 7th.—Medical, 8.
—— London Institution, 4.
Tuesday, 8th.—Civil Engineers, 8.
—— Photographic, 8.
Wednesday, 9th.—Geological, 8.

SUPPLEMENT

TO

THE CHEMICAL NEWS.

Vol. XXVII. No. 697.

ON METHYL-ALIZARINE AND ETHYL-ALIZARINE.*

By EDWARD SCHUNCK, Ph.D., F.R.S.

In a paper which I had the honour of reading before this Society some time ago,† I gave an account of a yellow colouring matter accompanying artificial alizarine, to which I gave the name of *anthraflavic acid*. Though the substance was at the time new to me, and apparently to others also, it is quite possible it may have been previously observed by those working with artificial alizarine, since the crude product is probably hardly ever quite free from it, and its presence would not be likely to escape the notice of anyone endeavouring to prepare pure alizarine from the manufactured article.

My analysis of the acid, and of its barium and silver salts, led to the formula $C_{15}H_{10}O_4$ for the acid, and I was therefore inclined to view it as a body homologous with alizarine, or alizarine in which H is replaced by CH_3. I supposed it to be derived from a hydrocarbon higher in the series than anthracene ($C_{15}H_{12}$?) contained in the ordinary anthracene of commerce, a body which is supposed by some chemists really to exist, and which would stand in the same relation to anthracene as toluol does to benzol. It was necessary to adopt some such hypothesis, since, as Græbe and Liebermann remark, in referring to my experiments, a compound obtained from anthraquinone by the same process as that yielding alizarine cannot possibly contain 15 atoms of carbon. The conversion of the acid into alizarine by the action of fusing caustic potash would, however, admit of explanation in accordance with my view, since the methyl presumed to be contained in it might be supposed to be eliminated and replaced by hydrogen during the process.

The examination of anthraflavic acid was subsequently undertaken by Mr. Perkin,‡ whose analysis of the carefully purified substance led to the conclusion that it is isomeric with alizarine. I do not wish to dispute the accuracy of this view of its composition, since a trifling admixture of some impurity, such as anthraquinone, might easily have given rise to the excess of carbon found in my analysis, though I may state that a specimen of the substance, prepared from some of the "by-product" of the manufacture of alizarine—kindly sent me by Mr. Perkin—and purified with great care, gave exactly the same composition as before.

Græbe and Liebermann ‖ have also examined a yellow crystalline body accompanying artificial alizarine, which is converted into the latter by the action of fusing caustic potash. They are of opinion that it is identical with anthraflavic acid, there being, indeed, little or no difference in the properties of the two substances. They assign to it the formula $C_{14}H_8O_3$, and consider it as monoxyanthraquinone, alizarine being dioxyanthraquinone. The results of their analysis of the substance and its barium compound differ however so widely from those obtained by Mr. Perkin and myself (particularly in this respect, that in the compounds of anthraflavic acid two atoms of hydrogen are replaced by metals, whereas in those of monoxyanthraquinone only one atom is replaced) as to lead to the conclusion either that there exists more than one body having the general properties—chemical and physical—of anthraflavic acid, or that we have not all of us been working with pure substances.

Without pronouncing any decided opinion on this point, which can only be determined by further investigation, and without entertaining any sanguine anticipation of being able to prepare anthraflavic acid directly from alizarine, it seemed to me that it might be of some interest to ascertain the nature and properties of the methylic and ethylic substitution products of alizarine obtained directly from the latter.

In order to obtain methyl-alizarine, I tried several methods. The first consisted in heating bromalizarine with iodide of methyl and metallic silver in closed tubes. This process yielded a small quantity of a crystalline substance, which I believed to be the compound sought for. The other method, which is one now often practised for obtaining methylic and ethylic substitution products, gave better results. Purified artificial alizarine was treated with a mixture of iodide of methyl, caustic potash, and a little methylic alcohol in closed tubes, at a moderate temperature. After heating for some days, the tubes were opened and emptied, and the excess of iodide of methyl having been evaporated, the residue was treated first with hot water, to remove the iodide of potassium, and then with a little cold alcohol. The alcohol—which dissolved out a brown resinous impurity—having been filtered off, the residue was treated with dilute caustic potash lye, in which the alizarine not acted on dissolved with a violet colour. The liquid having been filtered off, the residue, which consisted of the potassium compound of methyl-alizarine—a compound very little soluble in cold water—was washed until the percolating liquid began to be of a cherry-red colour. It was then treated with hydrochloric acid, and the orange-coloured flocks left undissolved were filtered off, washed, and dissolved in boiling alcohol. The alcohol, on cooling, deposited cystalline needles of methyl-alizarine.

Methyl-alizarine as thus prepared has the following properties :—When crystallised from boiling alcohol it appears in long yellow needles, having a reddish tinge, but without the semi-metallic lustre peculiar to alizarine which it generally resembles. When heated it is entirely volatilised, yielding a sublimate of yellow lustrous scales and needles. It is almost insoluble in boiling water, but dissolves easily in concentrated sulphuric acid, even in the cold, giving a cherry-red solution. It does not dissolve sensibly in caustic potash lye in the cold, but on boiling a bright cherry-red solution is obtained, which on cooling deposits dark red crystalline masses. The solution shows no trace of absorption-bands, but only a general obscuration of the green part of the spectrum, and in this respect differs widely from the alkaline solutions of alizarine, which exhibit such very characteristic absorption-bands. The solution in concentrated sulphuric acid does, however, show an absorption-band on the border of the green and blue, just like a solution of anthraflavic acid in the same menstruum, but far less distinctly than the latter, on account of the much greater obscuration of the parts of the spectrum adjacent to the band. On adding alcoholic potash solution to an alcoholic solution of methyl-alizarine the potassium compound is deposited in dark red needles, arranged in star-shaped masses. The sodium compound, prepared in the same way, crystallises in small light red needles. A watery solution of the potassium compound gives with chloride of barium a red flocculent precipitate. The alcoholic solution of methyl-alizarine gives no precipitate with acetate of lead. When treated with boiling nitric acid methyl-alizarine is dissolved and decomposed, and the solution on evaporation leaves a white crystalline residue, probably of phthalic acid. Methyl-alizarine undergoes no change when treated with strong caustic potash

* Read before the Manchester Literary and Philosophical Society, March 18, 1873.
† *Proceedings Lit. and Phil. Soc.*, Session 1870-71.
‡ *Chem. Soc. J.*, xxiv., 1109.
‖ *Liebig's Annalen*, clx., 141.

lye, even at the boiling temperature. It is only when fusing hydrate of potash is employed that decomposition takes place. If the operation be carefully conducted there is obtained, on the addition of water to the fused mass, a violet-coloured solution, which shows the absorption-bands of alizarine very distinctly. There is no doubt, therefore, that by the more energetic action of the alkali at the temperature of fusion alizarine is regenerated. Methyl-alizarine does not dye mordanted cloth when tried in the usual manner. It imparts hardly any colour to the mordants, and differs, therefore, in this respect from the parent substance more than in any other.

Though methyl-alizarine differs in most points very widely from anthraflavic acid, still the two substances are found to resemble one another as regards some of their properties. Both yield crystallised potassium and sodium compounds. Both are converted into alizarine by the action of fusing potassic hydrate, though both remain unchanged when treated with strong alkaline lyes. The action of both on the spectrum is very similar. Neither of them is precipitated from its alcoholic solution by acetate of lead. Both are incapable of dyeing mordants.

The analysis of methyl-alizarine gave numbers corresponding with the formula $C_{15}H_{10}O_4$. It is therefore alizarine in which one atom of hydrogen is replaced by methyl. It still remained to determine how this substitution takes place, whether it is one of the two hydroxyl atoms contained in alizarine the hydrogen of which is replaced by methyl, or whether the substitution is effected in a different manner. In the former case methyl-alizarine would contain only one atom of hydrogen replaceable by metals. The formula of methyl-alizarine being $C_{14}H_6(HO)(CH_3O)O_2$, that of the potassium compound, for instance, would be $C_{14}H_6(KO)(CH_3O)O_2$ and it would contain by calculation 13·3 per cent of potassium. Now the potassium compound prepared in the manner just described and dried first over sulphuric acid and then at 130° C., was found to contain 12·6 per cent of potassium. It is certain therefore that methyl-alizarine belongs to the class of compound ethers, being formed by the replacement of one of the hydrogen atoms of a bibasic acid by methyl. It has a similar composition to Mr. Perkin's diacetyl-alizarine. In the latter, however, two atoms of hydrogen are replaced by the compound radical acetyl. Diacetyl-alizarine seems also to be a much less stable body than methyl-alizarine.

Ethyl-alizarine may be prepared in the same way as the corresponding methyl compound, employing iodide of ethyl in place of iodide of methyl. The properties of the two substances are so nearly alike that they can hardly be distinguished from one another. The composition of ethyl-alizarine is expressed by the formula $C_{16}H_{12}O_4$.

Specimens of the two substances were shown along with some specimens sent for exhibition by Mr. Perkin, including the new colouring matter lately discovered by him, anthrapurpurine, and samples of dyed calico showing the different effects produced by alizarine and anthrapurpurine.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Monday, March 31st, 1873.

Professor Frankland, D.C.L., F.R.S., President, in the Chair.

The President, in his address on this, their thirty-second anniversary, congratulated the Society on its prosperous state, and the large increase of members it had received during the past year. The members being 624 in March, 1872, 76 had since been admitted, and it had lost 18; so that the numbers were now 682, exclusive of the 32 foreign members. The names of the 10 members who were deceased since the last anniversary were T. Bloxam, John Cargill Brough, Ernest Theophron Chapman, John Hunter, Henry Beaumont Leeson, F. Muspratt, Robert Rumney, Benjamin Charles Staples, Thomas Thomas, and J. Chapman Wilson. The President also noticed the very large number of original communications which had been read at the Society's meetings during the past year, fifty-eight in number, being greater than that received during any similar period since the foundation of the Society, remarking, however, that although it was extremely gratifying to find that we had made such progress in original research, we were still far from occupying the position we ought to do. This he believed was chiefly owing to the attitude which the universities assumed towards the prosecution of original investigation.

After the Treasurer had made his financial statement, which was satisfactory, showing a considerable increase in the balance in hand, the Secretary read the bye-law relating to the election of officers and council, who were then balloted for.

The following are the names of the gentlemen elected:—

President.—W. Odling, M.B., F.R.S.

Vice-Presidents who have filled the office of President.—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; E. Frankland, D.C.L., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; A. W. Williamson, Ph.D., F.R.S.; Colonel P. Yorke, F.R.S.

Vice-Presidents.—H. Debus, Ph.D., F.R.S.; A. Vernon Harcourt, M.A., F.R.S.; H. E. Roscoe, Ph.D., F.R.S. Maxwell Simpson, Ph.D., F.R.S.; J. Stenhouse, Ph.D., F.R.S.; A. Voelcker, Ph.D., F.R.S.

Secretaries.—W. H. Perkin, F.R.S.; W. J. Russell, Ph.D., F.R.S.

Foreign Secretary.—H. Müller, Ph.D., F.R.S.

Treasurer.—F. A. Abel, F.R.S.

Members of Council.—H. E. Armstrong, Ph.D.; A. Crum Brown, D.Sc.; Dugald Campbell; E. Divers, M.D.; B. F. Duppa, F.R.S.; A. Dupré, Ph.D.; G. C. Foster, F.R.S.; M. Foster, M.D., F.R.S.; H. McLeod; Peter Spence; Hermann Sprengel, Ph.D.; Thomas Stevenson, M.D.

The usual votes of thanks were then proposed. Dr. Williamson proposed the vote of thanks to the President, which was seconded by Professor Heaton. Mr. Warington proposed the Officers and Council, especially mentioning the senior Secretary, Mr. Vernon Harcourt, who has resigned his office; this was seconded by Dr. Armstrong. Professor Abel proposed the Auditors, seconded by Professor Foster. Mr. Bassett, the Editor and Abstractors, seconded by Dr. Debus.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 4th, 1873.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

Mr. Francis Nicholson, F.Z.S., was elected an Ordinary Member of the Society.

Mr. Baxendell read the following communication from Mr. S. Broughton:—

It appears there is some doubt as to the existence of ball discharge in thunderstorms. At the request of Mr. Baxendell I communicate an observation of such, seen during the approach of a storm, in 1854 or 1855, when walking from Altrincham to Timperley.

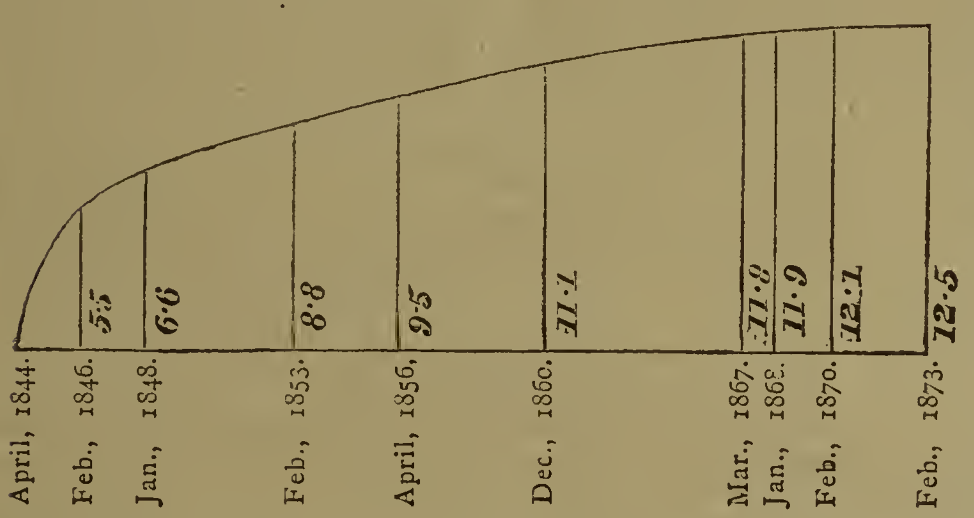
Over the edge of a cloud near the east horizon a flash of lightning was seen, and a ball, *apparently* the size of

one from a Roman candle, shot upwards through an arc of 20° or 30°. I cannot say that it went to another cloud, but that would most likely be so, as my attention was taken up watching the progress of the electric ball.

Mr. Brockbank, F.G.S., exhibited specimens of iron manufactured by the old Bohemian process from hematite ores in the South of Europe. Similar iron has also recently been sent to England from Japan, the high prices now ruling having attracted supplies of iron from distant countries.

Finished bar iron is produced at the present time, in countries where labour is cheap and charcoal plentiful, at an exceedingly low price as compared with present values in England. The specimens now exhibited cost only £6 per ton for the bloom and £8 per ton for the finished bar. The sizes of the bars are, however, very small; but it is a remarkable fact that on so small a scale iron of the very highest quality can be made and sold at half the price of English bars made on the largest scale with all the advantages of our modern machinery and appliances. It is believed that this iron is made by a similar process to that followed by the Romans in Britain, the remains of furnaces or "bloomeries" on Ennerdale Lake being of this class.

The President said that he had made another observation of the position of the freezing-point in the thermometer used in making the observations recorded in the *Proceedings* for April 16, 1867, and February 22, 1870. The gradual rise of the zero during twenty-nine years will be seen by the adjoining diagram, the ordinates representing divisions etched on the glass stem, each corresponding to $\frac{1}{12\cdot9}$ of a degree Fahrenheit.



"*On the Influence of Acids on Iron and Steel*," by William H. Johnson, B.Sc.—Will appear in our next.

Ordinary Meeting, March 18th, 1873.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

Mr. James Cosmo Melvill, M.A., F.L.S., was elected an Ordinary Member of the Society.

E. W. Binney, F.R.S., V.P., said that during the last week an interesting controversy had been going on in this city between the Town Clerk and the Professor of Chemistry at the Royal Institution as to the quality of the water supplied to Manchester. These disputants are well able to wage their own warfare, therefore it is not my intention to interfere with them. In these days no one doubts the blessings of a constant supply of pure and good water; but the latter quality is determined in a great measure by the purpose for which it is intended to be used. If for manufacturing and washing, then a pure soft water is no doubt most desirable; but it is very questionable if such a water, when conveyed any considerable distance in leaden pipes, is the best for the drinking purposes of a town population.

In the Report of the Commissioners for Inquiring into the State of Large Towns and Populous Districts, Dr. Lyon Playfair, the Commissioner who reported on the then supply of Manchester, appears to have directed little attention to the quality of drinking water for a town population which had to a great extent left off using the milk, porridge, brown bread, and oatcake of our forefathers, and resorted to sloppy tea, white bread, butter, and a little meat, for at page 411 of his Report he says—"In considering the best means for the extension of this benefit," alluding to a constant supply, "to the working classes, or in sanctioning the formation of new waterworks, it would be highly advisable to obtain evidence as to the quality of the water, particularly with regard to its harshness. The value of attention to this point will be obvious, when the difference of consumption of soap is considered. I found by various trials, in summer, that the Manchester water possesses a hardness equivalent to what would be obtained if 13 or 14 grains of chalk were dissolved in a gallon of pure water." The learned Commissioner gives the water at Aberdeen at 1 grain of chalk per gallon, and comparing that with the 14 of Manchester and the 12 of London, he concludes—"Thus the hard water of Manchester may be regarded as increasing the water-rent to a family of five individuals 16s. 8d. per annum, or £49,363 per annum to the whole town, a sum nearly double that of the present water-rental. But large as the cost entailed upon a town by a bad selection of water in the unnecessary consumption of soap, still greater loss is incurred in the wear and tear of clothes." This was written about thirty years since, and I have not the death-rate of Manchester in 1842. In that space of time how much money has been expended in Manchester by the public authorities in shutting up cellar-dwellings, closing grave-yards, removing pig-styes, altering ashpits and middens, opening new streets, and supplying pure water? I cannot tell its amount, but every ratepayer knows practically that it is very large. In looking at the rate of mortality for the week ending March 8th, as given in the *Manchester Guardian*, in the 21 leading places in the kingdom, it was at the annual rate of 28 per thousand. In London the rate was 27; Bristol, 31; Wolverhampton, 28; Birmingham, 28; Nottingham, 27; Liverpool, 31: Manchester, 36; Bradford, 26; Sheffield, 27; Newcastle-on-Tyne, 31. Now I believe the first-named five towns are supplied with hard water, and give an aggregate of 141, whilst the latter five are supplied with soft water, and give an aggregate of 151. This is a significant fact, and worthy of grave consideration. True it is only one week, and a whole year ought to be examined; but I imagine the results, if carefully gone into, will give no advantage to the use of pure soft water when compared with hard, for 27 is a very high rate for London. In building up the skeleton of an adult large quantities of the phosphates and carbonates of limes are required. The well to do, who consume plenty of butchers' meat, cheese, and new milk, may manage to obtain what nature requires; but for the poor, who live on sloppy tea, fine white bread, a little butter, a trifle of meat, and plenty of soft water, where are they to get their necessary supply from? It is not my intention to assert that the high rate of mortality is all due to soft water. No doubt there are many causes which help to produce it, but good, wholesome drinking water, containing carbonate of lime, and plenty of fresh air, which is hard to get in a close and crooked-built town of high warehouses, have, in my opinion, much to do with it. In my own case, I put a little lime in the drinking water used in my house, and I live on a sandy hill, well exposed to the winds of heaven. In all sanitary arrangements too much attention cannot be given to providing plenty of fresh air and as much light as practicable.

"*On Methyl-alizarine and Ethyl-alizarine.*" by Edward Schunck, Ph.D., F.R.S. (See page 171.)

The President exhibited a syphon barometer, the peculiarity of which consisted in the introduction of a small quantity of sulphuric acid over the ends of the mercurial column.

Mr. Spence, F.C.S., communicated to the Society the result of an experiment in heating a diamond, which will considerably modify the general impression as to that gem being combustible only at an extremely high heat.

A friend of his had brought over a number of diamonds from the African mines. Some of these were what is called "off colour," not being purely white, and he put one of these into Mr. Spence's hands to try some experiments for displacing the colour if practicable.

This diamond, the size of a small pea, was immersed in fire-clay in a small crucible, the clay being mixed with a little carbonate of soda and hydrate of lime; the crucible was then placed in a muffle, and for three days and nights exposed to a heat which at no time was beyond a low cherry-red. After cooling, the crucible was broken, and the lump of hardened fire-clay was carefully broken up to extract the diamond; after two or three fractures of the lump, an impression or hole in the indurated clay was discovered just at the spot where the diamond should have been, but not a vestige of the precious stone remained.

The only explanation of its departure that seems feasible is, that the soda carbonate, causticised by the lime hydrate, had, by its affinity for carbonic acid, assisted the oxygen of the atmosphere getting through cracks in the clay, to oxidise the pure carbon of which the diamond is composed at a vastly lower temperature than would in ordinary circumstances have been required; at all events this gem was entirely volatilised at a very low red heat.

NOTICES OF BOOKS.

Wœhler's Outlines of Organic Chemistry. By Rudolph Fittig, Ph.D., &c. Translated from the Eighth German Edition, with Additions, by Ira Remsen. Philadelphia: Henry C. Lea.

A well-arranged, compact, and at the same time comprehensive, manual of that department of chemistry which is still known by the provisional name "organic." The circumstance, mentioned by the translator in his preface, that the work, in its original German form, has gone through eight editions in rapid succession, is sufficient proof of its value. The author informs us that it is intended not as a "Text-book of Organic Chemistry, in the usual acceptation of the term, but a guide in connection with instruction. This accounts for and justifies the general brevity of treatment. The work includes the most recent discoveries, and can be confidently recommended to the student.

Outlines of Physiological Chemistry, including the Qualitative and Quantitative Analysis of the Tissues, Fluids, and Excretory Products. By C. H. Ralfe, M.A., M.B. London: H. K. Lewis.

This work commences with a summary of the objects of physiological chemistry. Next follows an introductory section on the composition and constitution of organic substances, the author, as he states in his preface, adhering to the "typical formulæ of Gerhardt instead of adopting the constitutional formulæ which now replace them in the more advanced (?) works on chemistry." We have then a succinct but clear account of the proximate principles, organic and inorganic, found in the animal system. We incidentally note the following passage:—"The various salts (with the exception of sodium chloride) pass through the system unaltered, and are recoverable from the urine and fæces." It is not long since it was proclaimed, with great flourish of trumpets, that unalterability in the system and elimination unchanged were the characteristics of a poison; yet it is now fully known that these attributes belong equally well to salts not merely innocent but necessary to the well-being of the system.

With the statement that "copper is only incidentally present in the tissues" we cannot agree. In the blood of the *Limulus* it is present in notable quantity, replacing iron more or less completely at different seasons of the year. In the red feathers of the Touraco copper is also a normal constituent, as was proved by Church, and fully confirmed by the editor of this journal.

Part IV. treats of the tissues and fluids, with their average composition in the human species. Tolerably detailed instructions are given for the quantitative analysis of blood, with its spectroscopic characters, an engraving of its absorption spectra, and directions for the recognition of blood-stains.

The determination of cream in milk by means of the lactometer is more a domestic than a chemical process. It happens that in a watered milk the cream separates out more completely and more readily than is the case with genuine samples. The analysis of urine, both normal and morbid, is described in detail, as also the characteristics of the principal urinary sediments and calculi.

The appendices treat of the metric system of weights, of the apparatus needed in the analysis of animal compounds, and of the preparation of standard solutions.

Dr. Ralfe gives, lastly, a list of authorities referred to. We cannot help regretting that the "Zoo-Chemical Analysis" of Gorup-Besanez has not been consulted.

We can recommend the book to medical students who wish to familiarise themselves with that part of chemistry bearing most directly upon their profession.

Varnish for Labels.—At a recent meeting of the Newcastle-upon-Tyne Chemical Society, Prof. Marreco said that Prof. Markoe (of Boston, U.S.) told him, some months ago, that the practice in Boston was never to varnish a label for acid bottles, but to use paraffin instead. They had applied it to a large number of bottles in the college laboratory, and it answered perfectly. The only thing necessary was to brush the paraffin on as hot as possible, so as to get a thin even coating; it looked as well as varnish, and stood a great deal better. It saved a good deal of trouble in sizing and varnishing, and five minutes after the bottle had been brushed it was ready for use. Dr. Lunge said that he had read some months ago, in a German journal, that the use of paraffin could be extended a great deal further; that instead of sealing the tops of bottles—sample bottles of bleaching-powder, and for other purposes—it was very convenient to have a small porcelain dish with paraffin always ready, which could be placed upon a lamp, and, as soon as it was warm, to dip the top of the bottle in it, and that gave as good a sealing as sealing-wax, or better, and caused very much less trouble. It had also been proposed to use stoppers made of solid paraffin for caustic soda samples; but he did not like this, because they broke so easily. What he had found to answer perfectly well was to rub some heated paraffin upon the stoppers in place of tallow. He found it a great deal cleaner, and answering in every way for this purpose.

Memorial to the late Prof. Sedgwick.—At a meeting held on Tuesday, the 25th ult., which was attended by a large number of scientific friends of the late eminent geologist, resolutions were passed that a geological museum be erected, to be called the Sedgwick Museum, and that a bust of the Professor should be placed in it. A Cambridge and a London Committee were appointed.

THE CHEMICAL NEWS.

VOL. XXVII. No. 698.

ON

DETERMINATION OF WAVE-LENGTHS BY MEASUREMENTS WITH A PRISMATIC SCALE.*

By Professor A. S. HERSCHEL.

THE following table of numbers will show how the method can be used with small spectroscopes. The second column of the table gives the inverse fourth power of the wave-length, or the fourth power of the number of whole undulations in 1 m.m. of each of the Fraünhofer rays named in the first column. The third column contains the differences of these numbers, which are very nearly proportional to the intervals between the same lines, as measured with a scale of equal parts in ordinary spectroscopes. The fourth and fifth columns contain the observations of the same lines made by Dr. Huggins with a spectroscope divided into minutes of arc, each of which represented four units of his scale, and the measured intervals between the lines. In the next column, the latter intervals are brought into comparison with the differences of the first calculated numbers of the table by multiplying them severally by the number 0·0077, corresponding to the calculated and observed intervals between the extreme lines B and H, of the spectrum in the two cases. Even with this wide range of comparison between the spectra, it will be seen that the calculated intervals are nearly equal to those obtained from the observations, or are nearly proportional to the observed ones.

Table of Inverse Fourth Powers of Wave-Lengths.

(1.) Fraünhofer lines.	(2.) Inverse fourth power of wave-lengths; 1 m.m. as unit.	(3.) Differences.	Dr. Huggins's Prismatic Scale. (4.) Observed position.	(5.) Intervals.	(6.) Intervals (compared with standard differences in column 3).
	Billions.				
B	4·454		449		
		0·969		140	1·078
C	5·423		589		
		2·870		413	3·179
D	8·293		1002		
		4·672		597	4·595
E	12·965		1599		
		5·087		601	4·626
F	18·052		2200		
		11·401			
G	29·453		(?)†	3077	23·685
		12·169			
H	41·622		5277		
Difference for the whole spectrum		37·168		4828	37·168

The complicated law of dispersion of light by glass prisms does not simply admit of a more exact approximation than this rule affords; but, if the comparison is confined to a smaller part of the spectrum than its whole range, sufficiently close measurements of wave-lengths may be obtained by this method. To calculate, for example, the wave-length of the line C from Dr. Huggins's observation of that line, and of the lines near it, B and D, of which the calculated interval by the table is 3·839, the measured intervals of C, and D from B are respectively 140, and 553 in Dr. Huggins's scale. Hence, by the rule of simple proportion, we find the interval of the line C from B on the scale of inverse fourth powers, thus—

$$553 : 3·839 :: 140 : x,$$

and $x = 0·972$, the interval required. Its real value is 0·969, as given in the table. By using fuller tables, containing inverse fourth powers of more numerous spectral lines, much closer approximations of the results might readily be obtained.

To determine the wave-length of the line C, as thus found by comparison with B and D, the interval from B is added to the tabular number for that line, thus $4·454 + 0·972 = 5·426$, and the square root of the sum is extracted twice, giving 1·526, which, multiplied by 1000, is the number of undulations of the ray C in 1 m.m.* The length of each undulation in tenth-metres (or ten-millionth parts of a millimetre) is found by dividing 10,000,000 by the latter number, thus:—

$$\frac{10,000,000}{1526} = 6553.$$

Angström's determination of the wave-length of the line C is 6561 tenth-metres, differing only by a small quantity from this result. With the larger kind of spectroscopes, lines nearer to each other in the spectrum than B and D would generally be chosen for comparison, and a more complete table of them, for such instruments, would be of great practical value; but with the simple means of measurement now devised and adapted by Mr. Procter to pocket spectroscopes, which are ordinarily of low magnifying and dispersive powers, the above standard numbers of the principal Fraünhofer lines will probably be found to supply a sufficiently copious and useful list for numerical determinations of wave-lengths from such simply and ingeniously recorded observations.

* Read before the Newcastle-upon-Tyne Chemical Society.

† N.B.—A different line, lying much further from F towards H than that described as G in the determinations of wave-lengths by Angström and other authors, appears to have been here observed, and represented by Dr. Huggins in his table of the metallic spectra as the line G of Fraünhofer's spectrum.

* The number of oscillations in a millimetre thus obtained by the double extraction of a square root is the scale adopted as the standard scale for recording spectral lines, in which a considerable table of them is being published by the British Association. The place of a line on this standard scale may readily be obtained directly, as above from the observations.

NOTE ON A

BRITTLE VARIETY OF SILVER FROM BOLIVIA.

By FREDERICK FIELD, F.R.S.

A SPECIMEN of silver, weighing about half a pound, has been recently sent from Bolivia. It has a brownish colour, resembling very much the minerals Domeykite or Algodonite (Cu_6As and $Cu_{12}As$), for which it was at first mistaken. Like those interesting compounds, it afforded a brilliant white metallic streak with the knife, and was capable of being reduced to powder to a great extent by the pestle. Analysis proved, however, that it contained neither copper nor arsenic, but consisted essentially of silver, with percentages of chlorine, ferric oxide, carbonate of lime, and a small amount of cobalt. After digestion for some days with dilute acetic acid, the carbonate of lime was entirely dissolved, and the brittle residue pulverised and quantitatively examined. It yielded—

Silver	78·12
Chloride of silver.. ..	12·01
Ferric oxide	9·34
Cobalt	0·40
	99·87

The analysis presented no peculiar difficulties, and, as it is known to chemists that a mixture of silver and its

chloride is very brittle, this little note would scarcely be worthy of record were it not for the fact that the silver in the mineral, after precipitation in the state of chloride from its solution in nitric acid, remained perfectly white after being exposed to sunlight for many days, while the metallic chloride, existing *as such* in the mineral, blackened immediately on exposure to light. Thus, when the powdered ore is treated with nitric acid, and the solution precipitated by hydrochloric acid, the resulting compound after thorough washing is not affected by the sun; whereas the residue, after digestion with weak solution of ammonia, filtration, and precipitation by an acid, yields a chloride of silver which is at once discoloured. This peculiar property of chloride of silver has been previously noticed. In a paper by the writer, in the *Quarterly Journal of the Chemical Society*, vol. x., p. 242, the following observation may be found:—"Lœwig has shown that chloride of silver is soluble to a considerable extent in nitrate of mercury, and crystallises, as the solution cools, in octahedra. When solutions of nitrate of silver and corrosive sublimate are mixed together, a precipitate of chloride of silver is formed, which, on boiling with the nitrate of mercury produced by the double decomposition, is partially dissolved, and the solution, after filtration, deposits chloride of silver in small crystalline grains. These crystals, after washing with water until no trace of mercury passes, and exposed to the sun's rays, do not blacken like the ordinary chloride. A considerable quantity was prepared and exposed moist to the direct rays of the sun for a month, and remained unaltered in appearance."

ON THE

INFLUENCE OF ACIDS ON IRON AND STEEL.*

By WILLIAM H. JOHNSON, B.Sc.

I.—*General Effects of Acid.*

Pieces of iron and steel wire of various qualities were immersed in sulphuric or hydrochloric acids for spaces of time varying from ten minutes to twelve hours, and then well washed with water and dried, and the following experiments made:—

1. On breaking one of the pieces of wire, and moistening the fracture, still warm from the effort of breaking it, bubbles were seen to rise through the water from the *whole* surface of the fracture, even when the piece was 0·412 inch diameter. Further, pieces of wire that had been immersed in acid, washed, coated with lime, dried, and drawn to a smaller diameter, thus removing any trace of acid on the surface, gave bubbles in the same manner. The bubbles are most abundant if the iron has been immersed in sulphuric acid, and may be seen several days after the iron has been removed from the acid. If steeped in hydrochloric acid, the bubbles are seen with difficulty and only after long immersion.

Bubbles are not apparent with steel, even after prolonged immersion, except the steel be very mild.

Test-paper was not sensibly altered in colour by the water on the fractures.

By exposure to the atmosphere, or more quickly by steeping in water, the above phenomena, as well as those to be mentioned later on, decrease in intensity, until at length they are no longer visible and the iron is quite restored to its original state; gentle heat greatly aids this. They also cease to be visible sooner if hydrochloric acid be employed than if sulphuric acid is used, doubtless because the latter is less volatile.

2. The fracture of a piece of iron or steel, immersed for one hour or more in either acid, is somewhat darker in colour than before. After several hours the fracture may be black in the centre, and more or less crystalline in appearance.

3. Pieces of iron or steel, heated in a confined space, after immersion in acid become slightly rusted. If air has free access during the application of heat, this is not the case.

It thus appears that heat expels the dilute acid from the interior of the iron, which, if not carried away with sufficient rapidity by the surrounding air, attacks the surface of the iron, forming an oxide or oxychloride of iron.

Sometimes, instead of a uniform coating of rust, the iron is simply spotted. The acid will in some cases, after lapse of time, find its way to the surface of the iron, and spot it with rust, even without the application of heat; this is particularly the case with iron which has been soaked in sulphuric acid.

It is this power which iron possesses of absorbing acid, and afterwards giving it off, which accounts for the difficulty hitherto experienced of coating iron with copper, tin, or any other metal in acid solutions; for the acid, on coming to the surface of the iron, is unable to make its way through the impervious coating of metal, and consequently, combining with the iron at the surface, forces the copper or tin off.

4. The universal effect of acid on iron and steel is to decrease its toughness. This brittleness is most marked with steel. Sometimes a coil of steel wire after immersion in acid will break if allowed to fall on the ground, and I have seen hardened steel, and steel containing a large percentage of carbon, fly in pieces as soon as it was immersed in acid without being touched at all.

II.—*Effect on the Weight.*

Pieces of iron and steel were immersed in acid for different periods of time, well washed in water, and weighed; they were then heated in a kitchen oven, and again weighed. The results are given in the table on opposite page.

In all cases except one they were found to have lost in weight, and the exception was probably owing to the increased weight caused by a slight coating of oxide over-balancing the loss occasioned by heating.

The gain in weight by immersion in H_2SO_4 is greater than by immersion in HCl.

In Experiments 1 to 4 the gain per cent is—

For immersion in HCl .. .. =0·010659
For immersion in H_2SO_4 .. .. =0·025126

or almost as 2 to 5—more accurately as 1 : 2·357.

In Experiments 5 to 7 the gain per cent for—

HCl .. .. =0·02918
H_2SO_4 .. .. =0·03714

as 1 : 1·284.

Experiments 9 to 13 show how rapidly steeping in water removes what the iron has taken up by immersion in acid; the loss in weight on subsequent heating being only about one-tenth of that in previous experiments where the iron had not been immersed in water any length of time.

III.—*Effect on the Breaking Strain and Elongation.*

The effect of immersion in acid on the breaking strain and elongation of iron wire naturally suggested itself as an interesting subject for inquiry. Accordingly a number of pieces of iron wire were immersed in hydrochloric acid for one or more hours, and then carefully tested for elongation and breaking strain. The pieces were then heated on a hot plate for some hours, and again tested, with the following general results:—

1. That immersion in acid dimishes the breaking strain of iron wire from ½ to 3 per cent, and steel wire about 4·76 per cent.

2. That immersion in acid appears in some cases to diminish, in others slightly to augment, the elongation of iron wire, and to augment the elongation of steel wire about 30 per cent.

Subjoined are the results of a few of the experiments on iron wire.

* Read before the Manchester Literary and Philosophical Society.

Table showing the Increase of Weight after Immersion in Acid.

	Quality.		Hydrochloric Acid. Weight in Grams. Before Heating.	After Heating.	Loss by Heating.	Gain per cent by Immersion.		Sulphuric Acid. Weight in Grams. Before Heating.	After Heating.	Loss by Heating.	Gain per cent by Immersion in Acid.
1.	Steel	0·124	49·81525	49·81500	0·00025	0·000502	*	50·56990	50·55516	0·01474	0·029156
2.	Mild steel..	0·126	47·36490	47·36020	0·00470	0·009923	*	43·85970	43·84990	0·00980	0·022350
3.	Best iron ..	0·122	47·48030	47·47495	0·00535	0·011260	†	43·25005	43·23965	0·01040	0·024052
4.	Char. iron..	0·125	43·20994	43·20020	0·00974	0·022540	†	42·34002	42·32974	0·01028	0·024285
	Total ..		187·87039	185·85035	0·02004	0·010659		180·01967	179·97445	0·04522	0·025126
	In acid five hours, then washed several times in water, and heated eighteen hours in an oven.										
5.	Mild steel..	0·165	78·69240	78·65170	0·04070	0·051870		71·36530	71·32490	0·04040	0·056640
6.	Best iron ..	0·165	81·68530	81·67220	0·01310	0·016040		85·98500	85·94000	0·03500	0·040720
7.	Char. iron..	0·165	78·69240	78·65170	0·01595	0·020280		84·09020	84·07515	0·01505	0·017960
	Total ..		239·07010	238·97560	0·06975	0·029180		241·44050	241·34005	0·09045	0·037470
	In acid three and a half hours, then well washed in water. Heated eighteen hours.										
8.	Steel	0·165	80·08010	80·06770	0·01240	0·015480		—	—	—	—
	In acid twelve hours. Heated thirty hours.										
9.	Steel	0·180	—	—	—	—		79·10020	79·09005	0·01015	0·012830
10.	Mild steel..	0·182 ‡	—	—	—	—		77·56980	77·56990	−0·00010	—
11.	Best iron ..	0·155	—	—	—	—		74·92055	74·91722	0·00333	0·004400
12.	Charcoal ..	0·158	—	—	—	—		61·42040	61·41990	0·00050	0·000814
13.	Ditto. ..	0·420	87·45715	87·45500	0·00215	0·002450		—	—	—	—
	In acid twelve to thirteen hours, then steeped in water for ten hours. Heated twenty-four hours.										

* Appearance of fracture crystalline, speckled and white; after heating, finer and greyer. † Annealed. ‡ Very slightly rusted after heating

Quality.	No.	Elongation. Immersed in Acid 1 hour. Per cent.	Heated. Per cent.	Breaking Strain. Immersed in Acid 1 hour.	Heated.
Annealed iron wire, 0·164 in. diam.	1	15	22	1176	1168
	2	19	20	1176	1162
	3	22	19	964	1008
Average ..		18·6	20·3	1105·3	1112·6
Annealed iron wire, 0·150 in. diam.	4	24	22	908	944
	5	24	21	908	930
	6	22	25	896	946
	7	21	23	914	908
	8	22	22	926	924
	9	24	24	925	924
	10	22	23	934	896
	11	22	21	930	928
	12	21	20	924	906
Average ..		22·4	22·3	918·4	922·8
Hard iron wire, 0·136 in. diam.	13	0·5	2	1230	1218
	14	2·5	3·5	1146	1230
	15	2	3	1200	1232
Average ..		2	2·83	1192	1226·6

IV.—*Effect of Pyroligneous Acid.*

The effect of pyroligneous acid on iron and steel appears to be exactly similar to that of hydrochloric and sulphuric acids, causing it to become more brittle, &c., though the effects are perhaps somewhat less intense. As in their case, heat restores the iron to its original toughness.

V.—*Effects of Acids on Copper and Brass.*

Sulphuric acid appears to have no effect whatever on copper. After eighteen hours' or longer immersion in sulphuric acid, copper is as tough as ever, the action being confined to the surface only.

Brass becomes rotten after long immersion in vitriol, doubtless because the zinc of which it is partly composed is attacked by the acid, and, as might be expected, heat does not restore it to its original condition. Prolonged exposure to a moist damp atmosphere appears to make brass brittle, just as acid does.

VI.—*Effect of Zinc on Iron.*

A piece of galvanised iron of good quality, which when cold several times resisted bending to and fro at right angles to itself, was raised to a red heat with such rapidity that only a small portion of the coating of zinc was vapourised. On then attempting to bend it, it broke off sharp, the fracture being short and crystalline. When cold, this piece broke with all its former toughness, the fracture showing a long fibre. The same piece was then heated till all the coating of zinc was driven off; it was then found impossible to break it. This clearly shows that the iron was not red-short, except when rendered so by the zinc.

The same experiments were tried with iron coated with lead and with tinned iron, but without the above results.

Some kinds of iron do not appear to be rendered red-short by zinc.

Possibly the above phenomenon may have some connection with the fact that zinc forms an alloy with iron at a red heat, containing from 2 per cent to 6 per cent of iron, and having a melting-point which is higher as the proportion of iron is greater, while lead and tin do not alloy with iron at this temperature. But still the iron appears to absorb the liquid zinc in a similar way to that in which it appears to take up acid on immersion in it, and with similar results.

Hitherto I have spoken of iron absorbing and occluding acid, as though this something which increases the weight of the iron, alters its tensile strain, &c., had been definitely proved to be acid; but, in the face of my having been unable to obtain any reaction to test-paper, this is very uncertain. Though the fact that the immersion of iron which has been soaked in an alkaline fluid greatly hastens its restoration to its original state, and the rusting of the surface of iron soaked in acid when heated in a confined space, all lead to the belief that acid is absorbed, though other bodies, such as gases, may be occluded at the same time.

The experiments of Professor Graham, in 1867, and more recently those of Mr. Parry, show that hydrogen, carbonic oxide and carbonic acid, and nitrogen are evolved from wrought-iron, cast-iron, and steel when heated *in vacuo*. Therefore it seems probable that a part of the hydrogen produced by the action of the acid on the iron

may be absorbed by the iron, its nascent state facilitating this; and when the iron is heated by the effort of breaking it, the gas may bubble up through the moisture on the fracture.

In Mr. Parry's experiments, while 1 vol. of iron evolved 2 vols. of gas when heated strongly *in vacuo*, 1 vol. of mild steel evolved only 0·13 of a vol. of gas. If, from a small evolution of gas during heating of steel *in vacuo*, we may argue a very small evolution of gas in steel soaked in acid, then we are led to suppose that the bubbles evolved from the hot moist fracture of a piece of steel will be very small or imperceptible, which experiments amply confirm.

THE SPECTRA OF THE METALLOIDS.

The January number of the *Ann. de Chim. et de Phys.* contains an important memoir by M. Salet, in which that physicist gives the details and results of a long series of researches on this subject. While many of these results are already well known, a brief *resumé* of M. Salet's work in this department of science may not be without value.

The author studied successively each of the families of metalloids established by M. Dumas, and describes for each of these substances the spectrum produced by electricity of high tension, and of low tension, the spectrum of absorption, and the spectrum which it gives on being introduced into a flame. Instead of the ordinary Plücker tubes with interior electrodes, M. Salet frequently used tubes quite similar in form, but of glass not readily fused, so that they might be heated to a red heat during the circulation of a current of oxygen intended to free them of all traces of carbon. Instead of electrodes in the interior, the enlarged extremities were furnished with metallic sheaths.

Hydrogen.—M. Salet obtained from hydrogen only one spectrum, that with three bright lines discovered by M. Angström; these lines being capable of enlargement, more or less, according to the temperature of the discharge. With M. Angström, he attributes the two other spectra which M. Wüllner obtained with hydrogen, the one to acetylene, the other to sulphur. No other spectrum of absorption was obtained from this gas than that furnished by the atmosphere of the sun and of several stars. The author was unable to obtain a discontinuous spectrum by the combustion of hydrogen in oxygen or in chlorine; the spectrum was always complete.

Chlorine.—From the difficulty of preparing with the mercury pump a Geissler tube of chlorine, M. Salet preferred to use a tube filled with this gas at ordinary pressure, making the disruptive discharge of the electric machine traverse it. For the detailed description of the spectrum thus obtained we must refer to the original memoir. M. Salet did not observe the absorption-spectrum of chlorine, and did not obtain a discontinuous spectrum from this substance by combustion.

Bromine.—With the disruptive discharge through bromine a yellow spark is obtained, and a spectrum composed of a great number of lines or of resolvable bands. With the induction coil the spark is nebulous, straight, and enveloped by a less luminous sheath. This sheath gives a pale continuous spectrum; it is formed by vapour of bromine heated red-hot. M. Salet observed, indeed, that the vapour of bromine may be rendered luminous by submitting it to a temperature sufficiently high, in a glass tube not readily fused, or by placing in it a platinum spiral kept incandescent by a current. The spectrum then furnished is continuous; but it is probable, he adds, that, with a greater illumination the bands of the first order would become visible.

Bromine gives an absorption-spectrum composed of shaded bands, without coincidence with the lines of the spectrum from disruptive discharge, and forming, so to speak, the negative proof of what Plücker has called a spectrum of the first order. There is no doubt, says M. Salet, that the molecules of bromine, the electric absorption of which causes these *minima* in the spectrum, would be capable, if luminous in the same circumstances, of emitting a light characterised by corresponding maxima. There are, then, *two spectra of bromine.*

Bromine introduced into the hydrogen flame did not give a discontinuous spectrum.

Iodine.—Iodine introduced into a glass tube from which the air had been carefully expelled, was then heated so as to fill the tube with a vapour more or less dense. With the coil, and with sufficient pressure, a bluish spark was produced, enclosed in a fusiform orange sheath which gives a continuous spectrum, while the spark gives a spectrum composed of a large number of bright lines. With the induction spark in a tube having external metallic armatures, and containing vapour of iodine at a very low pressure, a spectrum was obtained consisting of three luminous diffuse maxima; one of which, in the red, was divided by flutings. This is the primary spectrum of iodine. The red flutings correspond with the bands of the iodine absorption-spectrum, which forms, in some sort, the negative proof of the primary spectrum of this substance, while there is no coincidence between the absorption-spectrum and the spectrum of the second order.

Iodine can be heated to red heat much better than bromine; and, round an incandescent platinum spiral introduced into vapour of iodine, a veritable *flame without combustion* is produced.

Fluorine.—M. Salet endeavoured to determine certain elements, at least, of the spectrum of fluorine, by comparing the spectra of chloride and fluoride of silicium, and eliminating the common lines.

Oxygen.—The description given of the spectrum of bright lines corresponds to that given by Angström, but some lines are added. On the other hand, there are wanting some lines which have been attributed to this gas by Plücker and Hittorff. Oxygen gives neither a spectrum of absorption nor a spectrum of combustion.

Sulphur.—The spectrum of this metalloid was studied with a tube having external metallic armatures, and containing a little sulphur, which was heated more or less according to the pressure desired in the vapour thus produced. With the induction coil and low pressure, a spectrum of the first order of Plücker and Hittorff was observed. With the spark from a Holtz machine the spectrum observed was, on the contrary, entirely composed of bright lines, of which the author gives the wavelengths.

The absorption-spectrum of sulphur is difficult to obtain. The dark bands are especially visible in the blue; they coincide with those of the primary spectrum. The introduction of a certain quantity of sulphur into the hydrogen flame produces, in the portion of this flame having the highest temperature, a bluish-violet colouration, which, studied with the spectroscope, gives the primary spectrum of sulphur. The coloured space may be considerably increased by pressing the hydrogen flame against a sheet of water; the entire surface of contact becomes coloured with this blue light, which can then be spectroscopically analysed. The author considers that by this process one may detect, by simple colouration, without using the spectroscope, the presence in a hydrogen flame of 0·000002 gr. of sulphur.

Selenium.—Selenium gives also two different spectra—one of the first order, which may be obtained by combustion, either by volatilising the substance in coal-gas, or in a sheathed tube traversed by the current from an induction coil; and a spectrum of the second order, when the substance transmits the discharge of a Holtz machine.

Tellurium.—This metalloid also gives two spectra. The band-spectrum may be observed with a sheathed tube containing a little tellurium (the air having been expelled), and heated to a red heat, the induction current being then made to pass; also with the flame of a jet of hydrogen containing volatilised tellurium. The spectrum of the

second order can be obtained by the same process as that of the metals.

Nitrogen.—M. Salet obtained the band-spectrum of Plücker and Morren both with dried ammonia and with air, and thus demonstrated that it belongs really to nitrogen; a result confirmed by M. Wüllner by experimenting with this gas, not in combination, but prepared as pure as possible. The line-spectrum of nitrogen is obtained with the disruptive discharge. M. Salet, then, considers that nitrogen gives two spectra; an opinion contrary to that held by M. Angström and M. Schuster.

Phosphorus.—M. Salet could not obtain the band-spectrum by passage of electricity through phosphorus. Even with electricity of low tension he always observed the line-spectrum he describes. Phosphorus colours the hydrogen flame with still more intensity than sulphur. By using a sheet of water, or sending about the flame a quick current of cold air, this colouration, which is green, may be considerably increased, and one may then observe a bright spectrum of the first order, which is, with some bands in addition, the spectrum described by MM. Christophle and Beilstein. The coloured flame, obtained by the burning in air of a jet of hydrogen containing volatilised phosphorus, gives the principal bands of this spectrum.

Boron.—By the passage of the disruptive discharge in chloride or fluoride of boron, the author obtained a line-spectrum which yet was not sufficiently well defined for precise description. On the other hand, he describes the primary spectrum produced by the introduction of chloride or fluoride of boron, as also of boric acid into the hydrogen flame.

Carbon.—The results obtained for this substance were obtained from a study of the spectra of its compounds.

Silicium.—A beautiful line-spectrum may be obtained from the induction spark passing between two poles of silicium. The lines of silicium are found in the spectra of all the haloid compounds. These compounds give combustion-spectra of bands, which, with certain portions in common, vary notably from one combination to another.

M. Salet's researches, thus briefly sketched, form a valuable contribution to the science of spectrum analysis.

A. B. M.

NEW PROCESS FOR THE MANUFACTURE OF SULPHOCYANIDE OF POTASSIUM.*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

The methods by which this salt is now prepared for laboratory and other purposes necessitates several purifying processes, in order that the ultimate product may have the degree of purity required; thus we have first the formation of the crude article, by heating to tranquil fusion dry ferrocyanide of potassium with sulphur, and this product has to be treated in various ways in order to remove sulphocyanide of iron, alkaline sulphides, &c., from the salt in request.

The processes therefore necessary to accomplish this purification must largely add to its cost. To save this expenditure in labour and material I have sought to effect the economical manufacture of this salt by the application of a process or reaction which I have taken advantage of in discriminating the state in which sulphur exists on the surfaces of sulphurised gold.† This process consists in applying cyanide of potassium to such compounds at common temperatures, when any sulphur present in a free state would combine with it to form a sulphocyanide, but if present as a sulphide would only be transformed into a soluble sulphide.

In my first experiments, however, for the purpose of preparing this salt direct from cyanide of potassium and common flour of sulphur, I found that unless the temperature of the mixture was raised considerably, only a very small portion of the sulphur was taken up, and the product was then contaminated with the impurities I designed to omit.

This refusal of sulphur to combine freely with the cyanide at common temperatures was, I found, entirely due to the presence of some gas, probably air, which substance may readily be got rid of, as will suggest itself by pouring the sulphur into boiling water and keeping up ebullition for a few minutes. When the water and sulphur is quite cooled down the cyanide may be added to the sulphur in an equivalent proportion.

The quickest way to effect the combination is to suspend the wet sulphur in a porous bag near the top of the cyanide solution, when in a few days the combination will be complete, and a product obtained comparable in purity with that of the cyanide used. I need not state that the operation should be carried on in an air-tight vessel.

It is absolutely necessary that the cyanide used should be free from caustic alkali, otherwise sulphides would be generated: it is but rarely, however, that cyanide is thus contaminated.

If the precautions indicated are taken, the product is sufficiently pure for use in all the ordinary applications to which this salt is put in the laboratory.

* Read before the Wellington Philosophical Society.
† See *Trans. N.Z. Inst.*, vol. iii, p. 216.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, April 3rd, 1873.

Dr. Odling, F.R.S., President, in the Chair.

The minutes of the two previous meetings having been read and confirmed, Messrs. O. W. Sheppard and George Browney were formally admitted Fellows of the Society. The Secretary then announced the donations which had been made to the Society, and proceeded to read the names of candidates for election. For the first time—Messrs. Isidore Bernadotte Lyon and John Henry Baldock. For the third time—Messrs. E. H. Fison; Charles Thomas Kingzett; Alonzo J. Rider; William Andrew Prout, B.A.; Roland Finch; William Morgan, Ph.D.; and Henry Richardson, who were balloted for and duly elected.

The first paper, "*On a Method of Determining with great Exactness the Specific Gravity of Liquids*," was read by the author, Dr. H. Sprengel. His instrument consists of an elongated U-tube, furnished at each extremity with a capillary tube bent at right angles, one of which is drawn out to a fine point, and the other has a fine mark on it near the bend. The apparatus is first filled through the open capillary tube by means of suction applied at the one drawn out, and is then placed in a vessel of water maintained at the standard temperature. As soon as the temperature of the instrument and its contents has become constant, the volume of the liquid is adjusted by absorbing any excess from the drawn out end by means of filter-paper. It may then be removed from the water, carefully dried, and weighed. If the temperature be adjusted with care to 0·01° C., determinations may be made with accuracy to the fifth decimal place. The author described certain details necessary in using the instrument, and also gave results illustrating its great accuracy.

The President having thanked the author in the name of the Society for the description of his valuable and ingenious apparatus, Dr. Dupre remarked that he could fully testify to the great delicacy of the instrument, but it was necessary, in order to insure accurate results to the fifth place of decimals, to observe certain precautions.

The balance must be capable of weighing within 1-10th milligramme, the temperature must be very accurately determined, and the barometer must be observed during the weighings, or else a facsimile of the instrument should be used as a counterpoise.

"*Researches on the Action of the Copper-Zinc Couple on Organic Bodies*" (No. II., "On the Iodides of Amyl and Methyl"), by J. H. Gladstone, F.R.S., and A. Tribe, was then read by the former. Dr. Gladstone said he might be permitted to remark, in reference to the black deposit of the copper-zinc couple, that it generally contains more or less zinc; but the black colour does not depend on its presence, for copper deposited on zinc in strongly acid solutions is black; moreover, some specimens of the black deposit do not effervesce with acids; and, finally, the black deposit, when treated with sulphate of copper, retains its colour, so that the blackness seems to be due to the finely-divided state of the metal, as in the case of platinum black.

The couple was found to have no action on amylic iodide at 100°, whilst at the boiling-point of the latter substance secondary products were produced, probably owing to the high temperature. When, however, the two were digested together at 145°, a white crystalline compound perfectly analogous to ethiodide of zinc was formed, together with some amylic hydride, amylene, and amyl. The contents of the flask, submitted to distillation, yielded 20 to 30 per cent of zinc amyl, mixed with the hydrocarbons simultaneously produced, and from which it may be approximately separated by fractionation. On distilling the amyl-iodide of zinc *in vacuo*, upwards of 40 per cent of the theoretical amount of zinc amyl was obtained. With respect to the decomposition which takes place in the presence of water or alcohol, the analogy between amyl- and ethyl-iodides is perfect, pure amyl-hydride being produced.

The dry couple has no action on methyl-iodide either at the boiling-point of the latter or at ordinary temperatures; in presence of water or alcohol, however, the methyl-iodide is readily decomposed, giving off methyl-hydride or marsh-gas, thus offering a ready method of preparing that gas in the pure state.

The President, in thanking the author for his interesting communication, asked if he had tried the action of the couple on the sulpho-vinates, since it was possible they too might give alcoholic hydrides.

Dr. Mills suggested that bromobenzine would perhaps yield phenyl when submitted to the action of the couple.

Dr. C. R. A. Wright then read a paper "*On Cymene from Various Sources.*" The author has submitted cymene from eight different sources to careful examination. The methods by which it was obtained were the following:—(1). By acting on myristicol with phosphoric pentachloride, and washing with water, a liquid was obtained which, heated to 170° to 190°, evolved hydrochloric acid whilst a hydrocarbon, cymene, distilled over. (2). By the action of zinc chloride on myristicol, a compound, $C_{20}H_{30}O$, being produced at the same time as the cymene. (3). The product obtained by the action of phosphoric pentachloride on camphor was digested in a flask furnished with a vertical tube as long as hydrochloric acid was given off, and finally the cymene was distilled off. (4). After polymerising the terpenes present in the nutmeg hydrocarbon by the action of sulphuric acid, the unaltered cymene precontained in it was separated for examination. (5). The cymene precontained in oil of turpentine was separated from the terpene by a similar process. (6). Cymene from hesperidene.—On adding bromine to carefully cooled hesperidene, the two unite, forming hesperidine dibromide, which, under the influence of heat, splits up into hydrogen bromide and cymene, the latter amounting to 80 per cent of the hesperidine employed. (7). Cymene obtained by a similar process from the dibromide of the turpentine of nutmeg oil; the yield, however, is very much smaller. (8). Cymene from Cummin oil.

Careful analysis were made of these various specimens of cymene, all of which correspond to the formula $C_{10}H_{14}$. Their boiling-points (corrected), although varying one or two degrees, were all about 176° C.; and by the action of potassium dichromate and sulphuric acid, they all yielded pure terephthalic acid and a certain amount of acetic acid, but no isophthalic acid was produced, neither could any of the higher homologues of acetic acid be detected in the distillate from the chromic liquor. Moreover, the odour, density, refractive and dispersive powers of these eight samples were almost the same, so that there can be no doubt that the cymene obtained from these various sources is identical. In conclusion, the author discussed the relation which existed between cymene and benzol, as exemplified by the known dihydrides of cymene and the oxidation of cymene to terephthalic acid.

The President having expressed the thanks of the Society to the author for his valuable memoir, Dr. Armstrong asked if Dr. Wright had determined the proportion of acetic acid to terephthalic acid produced by the oxidation of the cymene.

Dr. Wright replied that he had been unable to do so quantitatively, but the amount produced was always considerable. He likewise drew attention to the error into which Kekulé had fallen, of supposing that there were two isomeric cymenes, one existing in Cummin oil, and the other obtained from camphor by the action of zinc chloride; this he attributed to the latter being a mixture of various substances, and not pure cymene.

Dr. H. E. Armstrong then read a paper entitled "*Communications from the Laboratory of the London Institution*" (No. XI. "Action of the Acid Chlorides on Nitrates and Nitrites;" Part I., "Action of Acetic Chloride"). The author was in hopes of being able to convert phthalic acid and its isomerides directly into the corresponding dinitrobenzines, by first preparing from them the nitro-compounds analogous to Schützenberger's acetate of chlorine, $C_2H_3ClO_2$, and then submitting these to the influence of heat. The acetate of chlorine under these circumstances splits up into carbonic anhydride and chloromethane, $C_2H_3OCl_2 = CH_3Cl + CO_2$; and the corresponding nitro-body would presumably be resolvable by the same means into carbonic anhydride, and the nitro-derivative of the hydrocarbon. It was thought such a series might be formed by the action of the acid chlorides on the metallic nitrates; for example:—

$$CH_3COCl + AgNO_3 = AgCl + CH_3CO(NO_2).$$

On trying the reaction, however, with acetic chloride, it was found to take place in quite another manner, a mixture of nitric peroxide and chlorine being evolved, and argentic chloride and acetic anhydride left, the ultimate result being expressed by the equation—

$$\begin{matrix} C_2H_3OCl \\ C_2H_3OCl \end{matrix} + AgNO_3 = AgCl + NO_2 + Cl + \left.\begin{matrix} C_2H_3O \\ C_2H_3O \end{matrix}\right\} O.$$

The author has also examined the action of acetic chloride on nitrites. With the potassic salt, a gas is immediately evolved which somewhat resembles chlorine in appearance, but is readily absorbed by water, and appears to be NOCl; towards the close of the reaction nitric oxide is also evolved. In all probability, the reaction takes place as represented by the equations—

$$CH_3.COCl + KNO_2 = CH_3.CO_2K + NOCl$$

and—

$$CH_3CO_2K + CH_3.COCl = \left.\begin{matrix} C_2H_3O \\ C_2H_3O \end{matrix}\right\} O + KCl.$$

The author proposes also to investigate three other reactions which may be expected to yield the acid nitrates, viz.:—(1) The action of nitrylic chloride on the metallic salts of the acids; (2) the action of nitric anhydride on the acid anhydrides; and (3) the action of nitrylic chloride on the acid anhydrides.

The thanks of the Society having been given to the author for his interesting communication, the President adjourned the meeting until Thursday, 20th of April, when a lecture "On the Heat Produced by Chemical Action," will be delivered by Dr. Debus, F.R.S., &c.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

January 30th and February 27th, 1873.

The President (Dr. Lunge) read the following "*Chemico-Technical Notes from Foreign Sources*":—

1. *On an Improvement in the Manufacture of Caustic Soda.*—It is very well known that the principal impurity in manufacturing caustic soda from "red liquors" or from "tank liquors," which cannot be removed by the process of "fishing," is sodium sulphide, and that the only practicable way for dealing with this compound is oxidising it to sulphate. Formerly, this oxidation was always done by an addition of sodium nitrate, of which from ½ to 2 cwts. per ton of caustic soda were required for the purpose. The quantity of nitrate can be materially lessened by blowing air through the caustic liquor, which oxidises the sulphide, but only slowly and, on a manufacturing scale, never completely if applied in the usual manner, viz., to the caustic liquor in a comparatively dilute state at a temperature necessarily below its boiling-point. Some makers use Hargreaves's process, consisting in forcing air into the liquid by means of a jet of steam, on the principle of Giffard's injector, and thus save a good deal, but never the whole, of the nitrate, and only by a considerable waste of fuel for the steam, which in reality costs much more than would be required for driving an air-pump of corresponding power. This process has been very materially improved by W. Helbig, of Gera, in Thuringia, who injects the air, instead of into the lyes, into the caustic pot itself, when the mass is already in red-hot fusion. The process is now used in most German alkali works, and is carried out as follows:—

The lye is concentrated in cast-iron "pots" as hitherto, up to the point where the cyanides are decomposed with evolution of ammonia and formation of graphite; the froth then subsides, and the mass becomes viscid. The fire is now increased, and the mass brought to a red heat, whereby it becomes more fluid. The pot is now covered with an iron lid, provided in the middle with a small sheet-iron funnel, and close to it with an iron pipe reaching to the bottom of the pot, through which air is forced by means of a pump. The graphite is seen floating on the surface, and can be scummed off, but it is mostly allowed to be burnt, as it is too crystalline to be of any use for lead-pencil making. The oxidation of the sulphides begin immediately, and is controlled by taking samples now and then. The air is blown in to such an extent that the mass is strongly agitated, and this is continued till the sulphides are very nearly, or till they are completely, oxidised, according to whether a white or a somewhat bluish product is desired. Then the fire is drawn, the damper is let down, the mass is allowed to clear for some hours, and then ladled out as usual.

The pipe for injecting the air is most suitably a thick wrought-iron tube, bent in a right angle, and suspended in the bend by a chain going over a pulley. The part reaching into the pot is closed at the end, and has in its side four small openings, in order to divide the air into finer jets; the other arm is connected with a cock attached to the blowing-pumps by means of an india-rubber tube.

2. *On the Cause of the Loss of Sodium in Leblanc's Alkali-Making Process.*—The celebrated manufacturer and chemist, Scheurer-Kestner, of Thann, in Alsace, has proved before that the above loss does not proceed from a reduction of sodium compounds to metallic sodium, which might be volatilised, but that the loss is mostly caused by the formation of insoluble sodium compounds remaining in the "tank-waste." He has continued his researches on this subject, and found that "black ash," obtained on the large scale from 100 sodium sulphate and 95 limestone, left a tank-waste containing on the average 0·39 per cent sodium, whilst a product made from 100 sulphate and 112 limestone left 1·36 per cent sodium in the waste. The average was not appreciably affected by using sometimes a mixing-coal having 18 to 20, and sometimes one having 10 to 12, per cent ashes. A continuation of these experiments showed that the amount of insoluble sodium increases quite proportionately to the amount of limestone employed in the said mixture. It is well known that any excess of limestone in this mixture is for the most part converted into caustic lime, and further researches of the same chemist have shown that it is the latter body to whose presence the larger or smaller percentage of insoluble sodium compounds must be attributed. Hydrate of calcium retains of itself only small traces of caustic soda, and, if boiled with the latter, the washed sediment shows only 0·13 per cent of sodium. But if, instead of caustic soda, sodium carbonate be used, which of course during the process is causticised, the sediment, after being completely washed, still retains 4·75 to 4·95 Na_2O. The latter process of course takes place when dissolving "balls" containing sodium carbonate and caustic lime, and it is quite natural that, as observed in practice, the absorption of sodium by the insoluble residue increases with the increase of caustic lime—that is, with that of limestone in the original soda mixture.

M. Scheurer-Kestner further examined the effect of the porosity of black-ash on the loss of sodium. The tank waste from porous black-ash contained 1·44, that from very dense black-ash 1·97 per cent sodium. This was the result of lixiviating on the large scale; but the two samples of black-ash ground to a fine powder and lixiviated in the laboratory, so that the influence of the larger or lesser porosity was eliminated, showed 0·85 and 0·80 per cent sodium; that is to say, no appreciable difference.

The natural inference is that the quantity of limestone in the mixture for soda-ash ought to be reduced to the lowest point consistent with the quality of the ash.

3. *On the Composition of Bleaching-Powder.*—Dr. Crace Calvert, of Manchester, last year published in the *Comptes Rendus* of the French Academy, a paper on the analysis and composition of bleaching-powder, the upshot of which was that, in opposition to the opinion generally held, when chlorine and slaked lime are brought together, only one-third of the chlorine enters into the state of calcium hypochlorite, and two-thirds into that of calcium chloride. His analytical method consisted in passing a current of CO_2 through a filtered solution of bleaching-powder, boiling, filtering off the calcium carbonate, converting it into sulphate, weighing the latter and calculating it as corresponding to the total of calcium hypochlorite, whilst the calcium chloride is estimated in the filtrate from the carbonate, either by an estimation of chlorine in the usual manner, or by evaporating, drying, and fusing the residue. He asserts that he confirmed his results by exhausting bleaching-powder with absolute alcohol, which only dissolves calcium chloride.

Now, M. T. Kolb, of Amiens, who is well known by his extensive and most careful researches about all processes connected with alkali making, draws attention to the fact that he has already previously proved conclusively that a solution of ordinary well-made bleaching-powder contains almost exactly 1 equivalent of hypochlorite to 1 of chloride, and has pointed to the corroborative fact that, if one allows a certain volume of chlorine to be absorbed by lime, the whole of this is set free again by the addition of an acid, whilst, if Calvert's opinion were correct, only two-thirds would be set free. Kolb seeks the cause of the discrepancy between Calvert's results, on the one hand, and his own, and the opinions generally held by chemists, on the other hand, in the analytical method employed by Calvert, wtth which Kolb disagrees *in toto*. Kolb points to the fact that, on boiling a solution of hypochlorous acid in the presence of recently precipitated calcium carbonate, a portion of the latter is converted into chloride. This causes the percentage of hypochlorite to appear smaller, and that of chloride larger than it is in reality. Another source of error is this:—that caustic lime is somewhat soluble in calcium chloride, and thus vitiates the estimation founded upon the weighing of the residue. He also demurs to Calvert's treating bleaching-powder with

absolute alcohol in order to separate calcium hypochlorite and chlorides; he states that on repeating the experiment he could find only traces of hypochlorite on the filter, which is nothing to be wondered at, as it seems hardly likely that alcohol could be brought into contact with such a strong oxidising agent as bleaching-powder without acting upon it, even up to the formation of chloroform. In any case a great deal of the hypochlorite must be converted into chloride and thus vitiate the result.

Kolb's own analytical method is as follows. He adds to a filtered solution of bleaching-powder ammonia, first in the cold, then heats to the boiling-point; thus the hypochlorite is converted into chloride, and the total chlorine is then estimated by silver solution. In another portion of the filtered solution the chlorine of the hypochlorites is estimated by Gay-Lussac's volumetric method. The total lime and other constituents are estimated by the ordinary methods in another sample of bleaching-powder, first treated with ammonia, in order to destroy the hypochlorites. He thus finds the proportions as stated above; on representing the analysis according to Calvert's method, he finds a result similar to that found by Calvert, but, of course, totally rejects it as being obtained by a faulty method.

Mr. Clapham said, with regard to the causes of the loss of sodium in the alkali-making process, there was no analysis given of the limestones which were used. It gave the different quantities of limestone used, but it did not give the analysis. They were left in the dark as to the purity or otherwise of the limestones which were employed. This appeared to be one feature which should be cleared up. But again, it goes no further than the simple experiment as to the effect of the limestone. It did not give any further information as to the other causes of loss in the ball process. It was very well known that they did lose sodium or soda in the balling process: but it did not go further than the simple fact that, in the case of limestone of a certain quality, no loss of sodium or soda takes place. He did not know whether any information could be given on this point of the analysis of the limestone.

The President said he had better remark at once, in answer to Mr. Clapham's observation, that in the original paper there was no analysis given of the limestone used in this process. As he did not see present the gentleman who mentioned this matter to him, he would observe that a similar observation had been made in a very large factory on the Tyne, where they used the same material as all other manufactories, viz., the London chalk. There are two large branch works at that factory; and in one of them they had been using a very much larger proportion of chalk than in the other; and at the end of the manufacturing year it was found that in that branch of the works where they had been using the excess of limestone their yield was very much smaller than in the other works. That was found out without any bias in favour of one or the other, as a matter of fact, and the gentleman in question mentioned it to him as bearing out M. Scheurer-Kestner's paper. Of course, it was very well known that there were a great many other sources of loss of soda in the balling process; but this paper only dealt with this individual source, and he believed made it somewhat clearer than it used to be. He believed that formerly this source of loss had been very much overlooked. The author had also dealt with the assumption pretty generally made before, that a great deal of the loss is caused by the volatilisation of soda, and he refuted the assumption that there is any loss, or at any rate any appreciable loss, caused by the sodium being reduced to the metallic state and volatilised; and he (the President) believed most chemists would agree with him upon this point. But he did not deal with one source of loss which he (the President) believed in some cases was very considerable, that was the mechanical carrrying away of part of the soda mixture; and he thought that between the two, the soda-ash left in the tank waste and the portion of the mixture mechanically carried away, most of the soda in the ball mixture would be accounted for, of course not all as available carbonate of soda, but a great portion of it as sulphate. But certainly nothing was more desirable than that those causes of loss should be known; for, if once well understood, it was very likely that the loss itself would be greatly lessened.

Mr. Clapham said, so far as the mechanical loss was concerned, there could be no doubt that that was considerable. He himself had tried an experiment some years ago as to preventing it. A considerable portion of that mechanical loss in the ball furnace was found afterwards as deposit in the evaporating pan, in the form of additional sulphate of soda; but, even after it had passed over the whole length of the pan, there was a considerable quantity passed into the flues, and, as a rule, he had found, after frequent trials of the deposit in those flues, that it consisted almost entirely of sulphate of soda. But, to prevent that, he contrived a damper, which shut off the draught from the furnace to the pan at the time when the fire-door for charging the furnace was open. That was done by attaching a chain to the door of the furnace. When the man opened the door of the furnace he naturally put the damper down, and at the same time it necessitated him, to prevent the place being filled with smoke and other matters, to open the damper into the main flue; in this way, impurities were prevented from going into the pan. He found that answered very well. Without that arrangement for the alteration of the damper, when there was no positive necessity, the workmen of course shirked the matter, and it was never done. But, by fastening it in such a way that when the door was opened, the damper connected with the pan went down, this loss or injury was avoided, and the sulphate of soda which was carried away by a draught could be collected afterwards in that depositing flue. This was one source of loss. But, in addition to the mechanical losses, there were chemical losses. There was no doubt in his mind that a very large portion of the loss which was sustained in the form of soda was owing to the impurity of materials used, especially if either the limestone or the clay contained much iron. The oxide of iron which the iron forms, the insoluble sulphates, combines very easily with the soda; and was one of the sources, at any rate, in addition to the limestone. Therefore, so far as he could ascertain, there appeared to be a greater loss of soda whenever the materials contained very much iron. He had tried that, and could speak to that fact.

Mr. W. C. Reid said that, in connection with this note on bleaching-powder, he might mention that in Deacon's new operation the chlorine was much more permanent than in the old one; and it seemed to show that at least a portion of the chlorine, when produced under pressure, seemed to be held mechanically by the lime. It had not the same smell as the bleaching-powder produced by the old process. He had met Dr. Crace Calvert at Mr. Deacon's one time; and he suggested that in the old process part of the manganese was carried over, and was the cause of the chlorine being given off. He (Mr. Reid) did not know whether that was so or not, but it seemed to bear rather upon the question to know that in Deacon's, where the gas is not passed over the lime under pressure, the chlorine is more stable, and there is not the same loss by exposure to the air, even if brought up to 36 or 37 per cent.

Mr. Clapham said, in connection with Deacon's process, there appeared to be no reason why they should not have adopted years ago the plan of drawing the gases through the bleaching-powder, instead of forcing them in with great difficulty, very considerable loss, and annoyance to the neighbourhood in which these works were situated. As Mr. Reid had been kind enough to refer to Deacon's process, and as he had had a good deal of practice with it, he would like to ask him whether he had found there was any appreciable volatilisation of the chloride of copper on the small marbles through which the chlorine passes.

Mr. Reid said there was very little on the top of the

marbles in the first compartment: that was the only place where they had found it yet; they had not found any in the pipes—not a trace. They had found it only in one or two of the compartments near the commencement. There was a little chloride of copper left on the surface there—not more than a few grains.

CORRESPONDENCE.

THE SODA PROCESS, AND PROPOSED IMPROVEMENTS.

To the Editor of the Chemical News.

SIR,—Referring to the concluding part of Mr. Hill's paper (CHEMICAL NEWS, vol. xxvii., p. 163), I beg to state that the "loss of sulphurous acid" by my process is not by any means "inevitable," as it is quite practicable to work with much less loss than is practicable in the old process, and it is quite possible to work without any loss whatever, and even burn a part of the evolved hydrochloric acid into chlorine and water.

As to the "tediousness" of the process, the salt does not require to be handled at all while in the converting-chambers, the labour in this part of the work consisting solely in putting the salt into the chambers and drawing out the finished sulphate.

The fuel required to make a ton of sulphate is not more than a third part of that required by the sulphuric acid process of making sulphate, as the gases are passed directly from the burners at a red heat, and the heat developed by the reaction of the sulphurous acid upon the salt also assists in maintaining the temperature. In fact, there is theoretically more heat developed than is requisite to maintain the temperature of the materials under the operation at the proper point, and fuel is used not so much to *heat* the materials as to provide a layer of heated gas to prevent loss of heat by radiation, and with every enlargement of the apparatus the consumption of fuel becomes less and less with the reduction of the proportions of radiating surface to the cubical contents of the chambers. No nitrate of soda is required in the process, and thus a very costly item in the manufacture of sulphate of soda is removed. Powdered rock-salt can also be employed, as well as white salt, which reduces the cost of the raw materials. The temperatures at which the materials are to be maintained do not exceed from 800° to 900° F., and there are therefore no high temperatures to cause the rapid destruction of the apparatus, and the wear and tear is quite inappreciable.

I shall be happy to satisfy Mr. Hill as to the correctness of the foregoing statements, by showing to him the process in operation, if he will pay me a visit.—I am, &c.,

JAMES HARGREAVES.

Atlas Chemical Works, Widnes,
April 8th, 1873.

TIN ORE.

To the Editor of the Chemical News.

SIR,—I think your correspondent "J. W." will find the following method, which I devised some twenty years ago, serve his purpose for the rapid estimation of tin in tin ore (*i.e.* native protoxide):—Finely powder in the agate mortar some 20 to 25 grains of the perfectly dry ore; place this into a small test-tube and weigh. Fuse about four times this weight of cyanide of potassium in a small and rather deep porcelain capsule over a Bunsen burner; when in calm fusion and quite red-hot remove the flame and project the ore into this. Now weigh back the tube difference equal weight of ore employed; replace the gas flame and keep in quick fusion for 15 or 20 minutes, by which time the oxides of tin and iron will be reduced to the metallic state, and lie as a sponge at the bottom of the capsule: pour the whole contents on to an iron plate, and when cold the mass will leave the iron. Put cake and capsule into a basin, and add water to dissolve the cyanate and excess of cyanide; carefully decant, and when sufficiently washed free from these salts, add HCl; the metal will dissolve, and after solution pour the whole and wash the capsule into a beaker; add metallic zinc until the last piece ceases to show a precipitate of tin. Break up the sponge with a rod, dilute, and when settled, carefully pour off the ZnCl, and wash until the tin is pure; again dissolve in HCl, dilute, and estimate tin by a standard solution of bichromate of potash, using IK and starch water. In my original method, published in the *Chemist* for May, 1853, I simply dissolved the metals as reduced by the cyanide in HCl, and estimated the tin by a solution of Fe_2Cl_3. The metals may be reduced by a stream of dry H, but with comparatively little advantage. I have done scores of estimations of tin in the ore by the methods here given. Little more than an hour is required for a determination.

I may here add by way of parenthesis that the mode of estimating tin by means of a solution of bichromate, and generally known as Dr. Penny's process, was in daily use in his laboratory at the beginning of 1850, several years before the date of Dr. Penny's paper, and was devised by Mr. Dale, now of the firm of Roberts, Dale, and Co., of this town.—I am, &c.,

PETER HART.

Ardwick Bridge Chemical Works,
Manchester.

MISCELLANEOUS.

Utilising Suint for the Manufacture of Prussiate of Potash.—The suint, which forms almost the third part in weight of the raw wool, has been found to be an excellent material for the manufacture of yellow prussiate of potash, which is used for making prussian-blue and other articles of commerce, inasmuch as, after heating, it consists of an intimate mixture of carbonate of potash and nitrogenous carbon. Formerly this suint was exclusively used for the production of potash. Havrez found, however, that it is three times as valuable when directly used for the manufacture of prussiate of potash. While 100 kilogrms. of dry suint, containing 40 kilogrms. pure potash, cost only 3 dols., 100 kilogrms. of the potash of commerce cost from 14 to 16 dols.. Thus it will be seen that, by employing the suint, 100 kilogrms. of potash may be obtained for 7·50 dols.

The Verifications of Physical Theory occur in the world of sense. Laying the theoretic conception at the root of matters, we determine by rigid deduction what are the phenomena which must of necessity grow out of this root: If the phenomena thus deduced agree with those of the actual world, it is a presumption in favour of the theory. If, as new classes of phenomena arise, they also are found to harmonise with theoretic deduction, the presumption becomes still stronger. If, finally, the theory confers prophetic vision upon the investigator, enabling him to predict the existence of phenomena which have never yet been seen, and if those predictions be found on trial to be rigidly correct, the persuasion of the truth of the theory becomes overpowering.—*Prof. Tyndall.*

Are not the Elements Molecules?—One of the tenets of the modern atomic theory, viz., that no compound can exist where the valences of its component elements are not all satisfied, is universally acceded to by writers on chemistry; but, in the very face of this statement, they nearly all rush into what appears to the writer to be a rank absurdity and inconsistency, and perhaps on the very next page they will assert that certain elements, for instance, tin, antimony, platinum, &c., are endowed with

the extraordinary faculty of behaving as dyads, triads, tetrads, or pentads, indifferently, according to circumstances. A convenient and full explanation occurs to me, by which this apparent inconsistency may be accounted for. *Imprimis :* To me it appears just as irrational to assert that an element can exist where its valences are not all satisfied as that a compound can. What then becomes of the other two valences of the tetrad tin, in the case of stannous chloride, $SnCl_2$? or of the other two, in the case of antimonious chloride, $SbCl_3$? My answer to these queries is, not that the valences have vanished, but that they are fully active in satisfying those of another similar molecule, or, in other words, the respective formulæ for the above salts are—

$$\begin{array}{l} Sn^{IV}\,Cl_2 \\ \| \\ Sn^{IV}\,Cl_2 \end{array} \quad \text{and} \quad \begin{array}{l} Sb^{V}\,Cl_3 \\ \| \\ Sb^{V}\,Cl_3. \end{array}$$

And now for the deduction from the following facts:—If antimony be dissolved in HCl, the trichloride, $SbCl_3$, is only obtained, and in the case of tin, the bichloride, $SnCl_2$, whereas, by projecting powdered Sb into chlorine gas, the pentachloride, or, of tin, the tetrachloride, is obtained. My deduction is that tin, antimony, or any other element, as a single atom, cannot exist, but that every atom, in the uncombined state, is bound by all its valences to one of its own number. Antimony, then, is—

$$\begin{array}{l} Sb^{V} \\ \| \\ Sb^{V}, \end{array}$$

and when acted on by HCl, where the negative affinity of the Cl is in a measure masked by the H, it is only capable of separating three of the Sb valences, and—

$$\begin{array}{l} Sb\,Cl_3 \\ \| \\ Sb\,Cl_3 \end{array}$$

results. Project antimony, on the other hand, into Cl gas, and now the powerful negative affinity of the Cl, not being diluted by the H, is capable of cutting apart all five of the antimony valences, and $SbCl_5$ is obtained. The same is true of tin, and, in fact, instances might be added *ad infinitum ;* but is not the above sufficient? My conclusion, then, is, that the elements are constant in their saturating power, and under all circumstances are endowed with the maximum number of valences which they show under any circumstances.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 31, 1873.

The Spectrum of Boracic Acid.—Lecoq de Boisbaudran.—The principal bands of boracic acid form one of those systems whose elements approximate to each other to decrease in intensity in proportion as they become more remote from their most brilliant member. The three small red bands of boracic acid can only be connected with the system of the larger bands by means of considerations which I am unable to develop here. The following are the lengths of the undulations measured from the centres of the larger bands. It must be remarked that the centres of bands so large and ill-defined are not easy to measure with great exactitude :—

		1st Diff.	2nd Diff.	3rd Diff.
δ	580·7	—	—	—
α	548·0	32·7	—	—
β	519·2	28·8	3·9	—
γ	494·1	25·5	3·7	0·2
ϵ	472·1	22·0	3·1	0·6
	452·9	19·2	2·8	0·3
About ..	435·9	17·0	2·2	0·6
				——
				1·7 Mean 0·4

The second differences decrease slowly from the red towards the violet, with a mean diminution of 0·4 from one term to another. If, accepting the constancy of the third differences, we adopt as the best probable measures those of the three most brilliant bands, α, β, and γ, the second difference will preserve the value 3·7, and the rectified position of the other bands will become :—

	Measured.		Calculated from α, β, and γ.		
			1st Diff.	2nd Diff.	3rd Diff.
δ ..	580·7	580·9	—	—	—
α ..	548·0	548·0	32·9	—	—
β ..	519·2	519·2	28·8	4·1	—
γ ..	494·1	494·1	25·1	3·7	0·4
ϵ ..	472·1	472·3	21·8	3·3	0·4
	452·9	453·4	19·9	2·9	0·4
	435·9	437·0	16·4	2·5	0·4

We may perhaps feel surprised to see that the band δ possesses much less intensity than α, more advanced in the system. This fact, though contrary to the general rule, is not rare; in such cases, setting out from the second band, the intensity diminishes almost regularly to the feeble margin of the system. The maximum intensity is still more rarely in the third band. I may mention the electric spectra of metallic aluminium, and of manganic chloride as examples of these peculiarities. I wish to call the attention of chemists to the advantage derived from the addition of a few drops of hydrochloric to the liquids on which the induction light is thrown in searching for boracic acid. Thus, when a solution of boracic acid in hot water under the action of the spark gave only a feeble spectrum, the addition of a trace of hydrochloric acid rendered it immediately brilliant, containing the same bands as those shown of a gas-flame, but larger. The enlargement is chiefly on the left margin of the bands towards the red.

On the Alcohol and Acetic Acid Normally Present in Milk, as Products of the Action of Microzymas.—M. A. Bechamp.—The object of this paper is to prove that the milk of cows, from the moment when drawn, contains really acetic acid and alcohol, and secondary, that the same cause continuing to act during and subsequent to fermentation, these products increase in the curdled milk. Fresh milk is mixed with a slight excess of oxalic acid, and at once submitted to distillation in a chloride of calcium bath, the temperature of which is kept at 120° C. to prevent the formation of incidental products. In this operation the formation of foam is the chief difficulty. 19-20ths of the milk are distilled over. The clear liquid has always an acid reaction. Excess of pure carbonate of soda is added, and rather more that a tenth part is collected, which is concentrated by distillation and rectification over carbonate of potash. The alcohol is known as such by its inflammability, by its products when oxidised with a mixture of bichromate of potash and sulphuric acid, by the formation of crystalline acetate of soda, and by the formation and analysis of acetate of silver. The acetic has been separated from the sodic residues from which the alcohol had been withdrawn. Milk spontaneously coagulated by exposure to the air yielded also alcohol and acetic acid. In this case, it was important to search for butyric acid or its homologues, products of the alteration of albumenoid matters; none could be found. It became interesting to seek alcohol and volatile acids in the milk coagulated in the stomachs of lambs. Here alcohol and acetic acid were found, along with a little caproic acid. Asses' milk yields also alcohol and acetic acid; which may, therefore, be inferred to exist in the milk of all Herbivora. In that of the Carnivora it has yet to be sought. A litre of cows' milk yielded 0·224 grm. of alcohol, expressed as acetic acid. In another case, the quantity was only 0·036 grm. In the milk found in the stomachs of lambs, the mycrozymas were accompanied by a great number of bacteria, a fact of importance. The author considers that alcohol and acetic acid are produced in the mammary glands by the action of the microzymas on the glucogenous matters of the milk. All microzymas appear to have this power, not merely with sugar, but with the acids of fruits. The author pronounces Liebig's doctrine of the alterability of the albumenoids in the phenomena of fermentation a serious error. He has already proved that in the fermentation of eggs the albumen remains unaltered. He announces that he will produce proofs that, when milk becomes sour, the casein and other albumenoid matter retain their essential properties unaltered. He has found that the rotatory power of casein is quadruple that of albumen. The casein of curdled, and that of recent milk, have the same rotatory power.

La Revue Scientifique de la France et de l'Etranger, March 29, 1873.

Contains nothing original relating to chemistry, but attention is called to—

Géodésie Francaise Depuis Deux Siècles.—E. Alglave.—An important contribution to ordnance surveys.

Bibliography.—"Traité de Climatologie Générale du Globe," par le Docteur Armand; Paris: G. Masson. "Guide Pratique du Fabri-

cant de Sucre," par N. Basset; 3 vols; Paris, 1873. This work is here stated to contain the most complete and recent matter, theoretical as well as practical, relating to the sugar-production industry.

Les Mondes, March 13, March 27, and April 3, 1873.

These numbers contain no original papers relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industielle, February 9, 1873.

Concentration of Sulphuric Acid (Hemptinne's Process.—From the contents of this paper it appears that the vacuum pan process of concentrating the acid is more commercially advantageous than the employment of platinum vessels.

American Journal of Pharmacy, March, 1873.

In addition to several original papers strictly relating to pharmaceutical science this number contains the following original matter relating to chemistry:—

New Reaction for Carbolic Acid.—C. Rice.—Into a 5-inch test-tube put about 10 grs. of previously powdered chlorate of potassa, pour upon it strong hydrochloric acid to the depth of 1 inch, and allow the action of the gas to proceed for about 1 minute, then dilute with $1\frac{1}{2}$ volumes of water, and remove the gas contained in the upper part of the test-tube by blowing the gas out by the aid of a bent tube. It is advisable not to omit this precaution since, otherwise, the subsequent addition of ammonia is frequently accompanied by a vivid flash of light. Pour next upon the liquid contained in the test-tube solution of ammonia to the depth of about half an inch, and remove the white clouds of chloride of ammonium by blowing gently through a glass tube as before. Now add a few drops of the liquid suspected to contain carbolic acid by pouring it down the sides of the tube. If any carbolic acid be present, the upper (previously colourless ammoniacal layer) will assume a colour varying, according to the quantity of carbolic acid present, from the darkest brown to red brown, blood red, and rose red. The colour appears first, either at the top when much acid is present, or below at the point of contact of the two layers of liquid when the quantity of carbolic acid is small in the form of a colour 1 part of carbolic acid in 12,000 may be distinguished. The same reaction is produced with creosote (Reichenbach's ?), but no other substance gave this reaction.

Improved Atmospheric Washing-Bottle.—W. J. Land.—Illustrated by a woodcut. This instrument consists of a washing-bottle to the neck of which is laterally soldered a glass tube, to which is tightly fitted a vulcanised india-rubber syringe bulb. The glass jet-tube passes in the usual manner through the india-rubber stopper or cork, and the water is forced through the jet by pressing the syringe bulb, the pressure ceasing, air enters through the jet-tube and fills the syringe-bulb again.

Artificial Ivory.—W. A. Welling.—The article alluded to is composed of 10 ozs. of white shellac, $4\frac{1}{2}$ ozs. of acetate of lead, 8 ozs. of ivory dust, and 5 ozs. of camphor. These ingredients are first reduced to powder, then heated and mixed, then pressed in heated moulds or formed into sheets, &c.

Gazzetta Chimica Italiana, Nos. 1 and 2 (double number), 1873.

Contains the following original papers and memoirs:—

Alleged Emission of Ozone from Plants.—Dr. G. Bellucci.—This monograph treats exhaustively on a question first raised by Dr. Scoutetten at Metz in 1856, who then stated that the oxygen evolved from plants under the influence of the direct sunlight is ozone. This opinion was in the same year proved to be erroneous by Cloez, and has since been frequently discussed, some authors holding with Scoutetten, others with the last-named *savant*. Dr. Bellucci gives in this essay a *resumé* of all the results of the labours of different authors, and next records the results of his experiments on the evolution of oxygen from plants (including water plants), and on the nature of this gas, which is stated not to be ozone. The ingenious mode of experimenting is described *in extenso*.

Normal Butylic Compounds and on Valeric Ether.—A. Lieben and A. Rossi.—From a foot-note appended to this essay it appears that its contents were published nearly 2 years ago in the *Ber. d. Deutsch. Chem. Gesells.*, from which it was quoted in the Chemical News.

On a Reddish-Coloured Vulcanised India-Rubber.—G. Dalsie.—This paper treats on the composition and colouring matter met with in some kinds of Perry's elastic bands which have been submitted to analysis by the author, who seems to be unaware that, while he finds antimony in the material, one of the sulphurets of that metal is now and then applied with other materials as a so-called vulcanising material.

Analysis of a Sulphuretted Water from the Source known as Santa Venera di Pozzo, Situated at the Eastern Foot of the Etna.—O. Silvestri.—The composition of this water is chiefly of local interest.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 244, April, 1873.

Contains no original papers relating to chemistry.

NOTES AND QUERIES.

Separation of Woollen from Cotton Fibre.—It is necessary in many cases to separate woollen warps or wefts from cotton wefts or warps. Will any of your readers be so kind as to state which process has worked most economically and satisfactorily for separating either of the before-mentioned fibres from the other?—Subscriber.

Aniline Inks.—It ought to be known that, as a rule, these inks are the least permanent of any in common use. Still, further, in view of recent great conflagrations, it is to be noted that no inks have been so generally destroyed, where used on books or paper subsequently charred in fireproof safes, as the various aniline inks. Mr. C. Gilbert Wheeler says, in the *Scientific American*, that a very extensive experience in restoring charred paper in the Chicago, and now in the Boston, fire, has convinced him that these inks, as a class, are beyond the power of the chemist to restore to legibility when exposed to a high temperature.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

326. G. Haseltine, Southampton Buildings, London, "An improved process of converting cast-iron into steel, applicable to the manufacture of edge-tools."—A communication from T. H. Alexander, Washington, D.C., U.S.A.—Petition recorded January 28, 1873.

476. R. Werdermann, Princes Street, Surrey, "An improved mode of, and apparatus for, purifying and refining metals and alloys."—Petition recorded February 10, 1873.

926. E. A. L. Roberts, Titusville, Penn., U.S.A., "Improvements in treating explosive compounds to impart safety thereto for blasting and other purposes."

931. E. Bevan, Birkenhead, and T. Drew, Tranmere, Cheshire, "Improvements in the treatment of vegetable substances to obtain paper-pulp and fibres."

945. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the treatment of peat for fuel, and in apparatus for the same."—A communication from J. F. F. Challeton, Paris.—Petitions recorded March 14, 1873.

957. J. Robey, Manchester, and G. F. Chantrell, Liverpool, "A new or improved filtering and deodorising medium."

963. H. Gardner, Holloway, Middlesex, "Improvements in apparatus and means for utilising spirituous substances and oils for the purposes of producing artificial light and heat."—Petition recorded March 15, 1873.

990. A. Barclay, Kilmarnock, N.B., "Improvements in the manufacture of pig-iron, and in furnaces or apparatus employed therefor."—Petition recorded March 18, 1873.

1044. E. E. Pearse, New Wandsworth, Surrey, "Improvements in the manufacture of glucose or grape sugar from rice and other grain, and in apparatus employed therein."

1046. J. Baggs, High Holborn, Middlesex, "Improvements in the manufacture of gas for illuminating and other purposes."—Petitions recorded March 20, 1873.

NOTICES TO PROCEED.

3362. L. Banks, Kingston-upon-Hull, "Improvements in the manufacture or composition of fuel."—Petition recorded November 12, 1872.

3417. F. Hahn, Berlin, "Improvements in the manufacture of steel and malleable iron, and in furnaces therefor."

3421. T. Bagley, Birmingham, "A new or improved varnish."—Petitions recorded November 16, 1872.

3464. E. Hills, Warsash, Hants, and B. Biggs, Laurence Pountney Hill, London, "Improvements in deodorising and purifying sewage and other excrementitious matters, and in obtaining certain useful products therefrom."—Petition recorded November 20, 1872.

551. D. Hutchison, Mile End, and W. G. Bridges, Stepney, Middlesex, "An improved composition for removing and preventing incrustation in boilers."—Petition recorded February 14, 1873.

743. R. K. Whitehead, Walmersley, near Bury, Lancashire, "Improvements in the manufacture of size."

744. T. Cadett, Rosherville, Kent, "An improved artificial fuel."—Petitions recorded February 28, 1873.

823. W. Wright, Sheffield, "Improvements in the manufacture of gas for heating and illuminating purposes, and in apparatus for the same, parts of which are applicable to other purposes."

828. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphates of soda and of potassa, and in the production of chlorine."—Petitions recorded March 7, 1873.

PATENTS SEALED.

2913. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improvements in the preparation or production of disinfecting, antiseptic, and cleansing liquids."—Dated October 3, 1872.

2934. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improved manufacture of fluids for deodorising and disinfecting purposes."—Dated October 4, 1872.

3525. J. Mitchell, Westminster, "A new or improved cretaceous hydrocarbon fuel."—Dated November 25, 1872.

335. J. A. H. Toulson and T. Harmer, Leeds, Yorkshire, "Improvements in the means employed for freeing glass from carbon,

grease, or other substances that may adhere to its surface."—Dated January 28, 1873.

393. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Dated February 1, 1873.

MEETINGS FOR THE WEEK.

Tuesday, 15th.—Civil Engineers, 8.
Wednesday, 16th.—Meteorological, 7.
—— Society of Arts, 8.
Thursday, 17th.—Zoological, 4.
—— Chemical, 8.

THE CHEMICAL NEWS.

Vol. XXVII. No. 699.

ON THE

RADIATION OF HEAT FROM THE MOON, THE LAW OF ITS ABSORPTION BY OUR ATMOSPHERE, AND ITS VARIATION IN AMOUNT WITH HER PHASES.*

By the EARL OF ROSSE, D.C.L., F.R.S., &c.

In this paper is given an account of a series of observations made in the Observatory of Birr Castle, in further prosecution of a shorter and less carefully conducted investigation, as regards many details, which forms the subject of two former communications† to the Royal Society.

The observations were first corrected for change of the moon's distance from the place of observation and change of phase during the continuance of each night's work, and thus a curve, whose ordinates represented the scale-readings (corrected) and whose abscissæ represented the corresponding altitudes, was obtained for each night's work. By combining all these, a single curve and table for reducing all the observations to the same zenith-distance was obtained, which proved to be nearly, but not quite, the same as that found by Prof. Seidel for the light of the stars. By employing the table thus deduced, and also reducing the heat-determinations obtained on the various nights for change of distance of the sun, a more accurate phase-curve was deduced, indicating a more rapid increase of the radiant heat on approaching full moon than was given by the formula previously employed, but still not so much as Prof. Zöllner's gives for the moon's light.

By employing Laplace's formula for the extinction of light in our atmosphere, the heat-effect in terms of the scale-readings was deduced, and an approximation to the height of the atmosphere attempted.

From a series of simultaneous measurements of the moon's heat and light at intervals during the partial eclipse of November 14, 1872, when clouds did not interfere, it was found that the heat and light diminish nearly if not quite proportionally, the minimum for both occurring at or very near the middle of the eclipse, when they were reduced to about half what they were before and after contact with the penumbra.

NOTE ON THE

SYNTHESIS OF MARSH-GAS AND FORMIC ACID, AND ON THE ELECTRIC DECOMPOSITION OF CARBONIC OXIDE.‡

By Sir B. C. BRODIE, Bart., D.C.L., F.R.S.,
Late Waynflete Professor of Chemistry in the University of Oxford.

In connection with the investigation on the electric decomposition of carbonic acid gas referred to in a previous communication to the Society, I was led to submit a mixture of hydrogen and carbonic oxide gas to the action of electricity in the induction tube, the mixed gases being circulated through the tube by means of an apparatus which I will not now describe. A contraction was soon observed to have taken place, which at the end of an hour amounted to 10 c.c. The rate of contraction steadily diminished, and during the fifth hour of the duration of the experiment amounted to only 2 c.c. The experiment was stopped, and the gas analysed with the following results in two several analyses:—

	I.		II.
Carbonic oxide..	61·65	Carbonic oxide..	61·35
Hydrogen	32·16	Hydrogen	32·34
Marsh Gas ..	6·14	Marsh Gas ..	6·31
	100·00		100·00

A small quantity (about 2 per cent) of nitrogen was also contained in the gas, together with a trace of oxygen, which have been omitted from the calculation.

The result of this reaction is expressed in the following equation:—$CO+3H_2=CH_4+H_2O$.

This fundamental experiment, which constitutes the basis of a new method of chemical synthesis, susceptible of the most varied applications, and of peculiar interest in reference to the explication of natural phenomena, was commenced by me on the 10th of January last, at Oxford, in the laboratory of my friend and successor in the Chair of Chemistry, Professor Odling; and two analyses of the gas were completed, and the results attained in the course of a week from that date.

In a similar experiment made with a mixture of hydrogen and carbonic acid gas, a contraction also occurred, attended with the formation of water. The gas which resulted from the experiment was found to consist (after the absorption of carbonic acid) of hydrogen and carbonic oxide, together with a little marsh-gas. Traces of oxygen and nitrogen were also present. Minute drops, too, of an oily liquid appeared in the tube. This liquid, after the conclusion of the experiment, was dissolved in a small quantity of water. The solution was strongly acid and had a pungent taste. It reduced an alkaline solution of terchloride of gold and an ammoniacal solution of nitrate of silver. These reactions are the characteristic properties of formic acid, of which we may infer the synthesis to have been effected according to the equation—

$$H_2+CO_2=H_2CO_2.$$

I may avail myself of the present opportunity to place on record the following important facts in reference to the action of electricity on carbonic oxide gas.

When pure and dry carbonic oxide is circulated through the induction-tube, and there submitted to the action of electricity, a decomposition of the gas occurs, attended with a gradual and regular contraction, which in the form assumed in my experiments, occurred at the regular rate of about 5 c.c. in an hour. Carbonic acid is formed, and simultaneously with its formation a solid deposit may be observed in the induction-tube. This deposit appears as a transparent film of a red-brown colour, lining the walls of the tube. It is perfectly soluble in water, which is strongly coloured by it. The solution has an intensely acid reaction.

The solid deposit in the tube, in the dry condition before it has been in contact with water, is an oxide of carbon. Samples, however, made in different experiments do not present precisely the same composition; but nevertheless they appear to belong to a certain limited number of forms which repeatedly occur, and may invariably be referred to the same general order or system. This system is, or appears to be, what I may term an homologous series of "oxycarbons," of which the unit of carbon with the weight 12 may be regarded as the first term, and of which the adjacent terms differ by an increment of carbonic oxide (CO) weighing 28, precisely as homologous series of hydrocarbons differ by the increment CH_2 with the weight 14. I have succeeded in identifying by analysis two at least of these substances, namely the adjacent terms C_4O_3 and C_5O_4. From this point of view these peculiar bodies are members of a series of oxycarbons analogous in the oxycarbon system to the series of hydro-

* Abstract of the Bakerian Lecture, delivered before the Royal Society, March 27.
† *Proceedings of the Royal Society*, vol. xvii., p. 436; vol. xix., p. 9.
‡ Read before the Royal Society, April 3.

carbons of which the unit of carbon is the first and the unit of acetylene, C_2H_2, is the second term, the oxycarbon C_4O_3 being represented in that series by the hydrocarbon crotonylene, C_4H_6, and the oxycarbon C_5O_4 by the hydrocarbon valerylene, C_5H_8.

ON AN AIR BATTERY.*

By J. H. GLADSTONE, Ph.D., F.R.S., and ALFRED TRIBE, F.C.S.

The galvanic battery which we are about to describe is founded on a reaction that we brought under the notice of the Royal Society last spring.† We then showed that if pieces of copper and silver in contact are immersed in a solution of nitrate of copper in the presence of oxygen, a decomposition of the salt ensues, with the formation of cuprous oxide on the silver and a corresponding solution of the copper, while a galvanic current passes through the liquid from copper to silver. We stated, moreover, that this was no isolated phenomenon, but only one of a large class of similar reactions. It seemed desirable to examine more fully the history and the capabilities of the electrical power thus produced.

It was previously ascertained that the combination of the oxygen takes place only in the neighbourhood of the silver; and the following formulæ may serve to render the chemical change and transference more intelligible:—

Before contact—

$$m\text{Ag}+\text{O}+\text{Cu}2\text{NO}_3+\text{Cu}2\text{NO}_3+n\text{Cu};$$

after contact—

$$m\text{Ag}+\text{Cu}_2\text{O}+\text{Cu}2\text{NO}_3+\text{Cu}2\text{NO}_3+(n-2)\text{Cu}.$$

This action is evidently a continuous one until either the oxygen or the copper fails.

Now the oxygen of the atmosphere is practically unlimited in amount, but there is a difficulty in bringing any large quantity of it into contact at once with the silver and the dissolved salt.

To facilitate this, we arrange that the silver plate should have a horizontal position just under the surface of the liquid in the cell; and, in fact, we convert it into a small silver tray full of crystals of the same metal, which rise in projections to the very surface. The copper plate lies horizontally under it, separated, if need be, by a piece of muslin, and connection is made by a wire as usual. The vertical part of the copper plate, from a little above the liquid to the bend, should be varnished; otherwise solution principally takes place there, which causes the horizontal part of the plate to drop off. Holes are made in the silver tray with the view of shortening the communication between the air-surface and the copper plate and of facilitating the movements of the salt in solution. The solution itself may be contained in a shallow trough or saucer.

That dissolved oxygen is absolutely necessary for this chemical change has been already shown; but it was interesting to measure by a galvanometer the difference of the currents obtained by means of an ordinary, that is aërated, solution of copper nitrate, and one from which the air had been separated to the greatest possible extent. A Thomson's galvanometer was employed, which had a resistance of 2631·5 units at 18·3° C. Two cells were prepared with vertical plates and alike in all respects, except that the one contained an ordinary 6 per cent solution of copper nitrare, and the other a similar solution which had been deoxygenised by the means described in our former paper. Another experiment was made with a different pair of cells and an 11 per cent solution. It was necessary to use the 1-99 shunt; and the following were the amounts of deflection:—

Time after immersion.	Expt. I.		Expt. II.	
	Oxygenised.	Deoxygenised.	Oxygenised.	Deoxygenised.
1 minute.	78	14	130	11
4 minutes.	72	9	90	8
12 ,,	68	6	75	6
49 ,,	—	—	58	3·5

The contrast is evident. That the deoxygenised solution does give a deflection at all is due partly to the difficulty of excluding air, and partly, perhaps, at first to the oxygen condensed on the surface of the silver plate. The effect due to the water itself is inappreciable.

From the nature of the reaction it might be expected that the current would gradually diminish on account of the using up of the dissolved oxygen in the neighbourhood of the silver; such a diminution always does take place, at least after the first few vibrations of the needle.

It might be expected, too, that when the amount of action has run down considerably, the mere moving of the liquid so as to bring fresh parts of the solution against the silver would augment the currents. It does so.

The same might be predicted from stirring up the crystals of silver in the tray so as to expose new surfaces. This also was found to be the case.

And, again, it might be anticipated that if the wire were disconnected for a time so as to allow the oxygen to diffuse itself from other parts of the solution, and the connection were made, the current would be found as strong, or nearly so, as before. That also is true in fact.

A cell with the plates connected by a wire was placed under a bell-jar full of air over mercury. The mercury gradually rose inside, as might be expected from the absorption of the oxygen in the air.

The necessity of oxygen and the avidity with which it is taken up are both illustrated by the following experiment:—Two cells with horizontal plates were prepared alike in every respect, except that the first was filled with a solution simply deprived of oxygen, the second with a solution through which a stream of carbonic acid gas had been passed for some time. The first was placed in the air, the second in a vessel from which the air had been expelled by allowing carbonic acid gas to flow into it for an hour or two.

The deflections obtained were as follows, th[e] 1 999 shunt being used and the temperature being 13·7° C.:—

Time after immersion.	In air.	In CO_2.
1 minute.	165	76
5 minutes.	135	62
10 ,,	135	58

As the cell in an atmosphere of carbonic acid gas showed considerable action, in fact nearly half as much as that in the air, each cell was short circuited for twenty-three hours, with the expectation that any oxygen in the closed vessel would be used up; and, indeed, the most prominent crystals of silver in the cell in carbonic acid gas became reddened, while a cuprous deposit extended over the whole of the crystals in the other cell. When, however, the short wires were removed and the galvanometer interposed, the cell in the air gave a deflection of 136, practically the same as before, but that in carbonic acid gas, instead of showing a great decrease, rose to 80. It was then found that the vessel containing the latter slowly admitted air; so the contents were swept out by a fresh stream of carbonic acid gas, and it was made properly air-tight. After connection by a short wire for three days the galvanometer indicated a deflection of 20, that of the cell in the air being 110, temperature 10° C. As this showed a very great reduction of the chemical action, carbonic acid gas was again passed through the vessel for an hour or two; and after a connection of two more days the indication of the galvanometer was only 3, while the other cell gave 115, the temperature being now 10·5° C. The action, therefore, was at last reduced almost to nothing; and the original fault in the experiment brought out, perhaps more clearly than would otherwise

* Read before the Royal Society, April 3.
† *Proc. Roy. Soc.*, April, 1872, vol. xx., p. 290.

be seen, how eagerly the solution will absorb even minute quantities of oxygen from the surrounding gas.

An important point to determine was the best strength of the copper nitrate solution. Six per cent was generally preferred, for two reasons:—first, it gives about the maximum of effect—a solution four times as strong gives less than half the deflection, and a solution only a quarter as strong gives only two-thirds; secondly, a stronger solution than this 6 per cent is apt to produce a deposit, not of pure cuprous oxide, but of a subnitrate, which was supposed to clog up the silver crystals to a greater extent.

Another point investigated was the best proportion between the areas of the metallic surfaces. Experiments were made with vertical plates, in which the silver was kept at a uniform size and the copper was diminished by covering it more and more with varnish; and another set was made in which the copper remained the same, while the silver plate was reduced.

The results may be thus exhibited:—

Proportion of surfaces.		Deflection.		
Silver.	Copper.	Expt. I.	Expt. II.	Expt. III.
1	0·25	24	23	—
1	0·50	28	27	—
1	0·75	31	30	—
1	1·00	33	32	28
1	1·33	—	—	28
1	2·00	—	—	32
1	4·00	—	—	30

The increase of the copper surface, therefore, has comparatively little effect.

Proportion of surfaces.		Deflection.		
Copper.	Silver.	Expt. I.	Expt. II.	Expt. III.
1	0·25	—	—	7·5
1	0·50	—	—	16
1	0·75	—	—	21
1	1·00	33	32	28
1	1·33	41	40	—
1	2·00	56	54	—
1	4·00	96	92	—

The increase, therefore, of the silver or negative metal causes an almost proportionate increase in the chemical action. This, doubtless, arises from the necessity of oxygen, and explains the value of the large surface exposed by the silver crystals in the tray.

The effect of heat on the action of this cell was examined; it increases the action greatly: thus an arrangement which gave a deflection of 40 at 20° C. gave one of 250 at 50° C.; and the augmentation was observed to be much more rapid in the higher than in the lower portions of this range of temperature.

If the formula given above for the reaction be a true one, it follows that every atom of copper deposited on the silver in the state of suboxide must be compensated by an atom of copper dissolved from the copper plate. This was proved quantitatively. In a cell that had been in action for a week the loss of the copper plate was 0·391 grm., while the suboxide deposited on the silver was found to be equivalent to 0·398 grm. of metallic copper. This deposit of suboxide, though it soon forms apparently a complete covering to the silver, does not greatly diminish the action; it is probably porous, besides being itself a conductor of electricity. In some cases we have found it deposited in crystals sufficiently large to be seen by the naked eye, and which are shown by a magnifying glass to be regular octahedra.

The internal resistance of this battery, as might be expected, is small.

The electrolytic power of the current was examined. One cell, the plates of which were about 2 inches in diameter, was found sufficient to decompose such metallic salts as the nitrates of copper, silver, or lead, copper sulphate or stannous chloride, in aqueous solution, when platinum was used for the negative electrode, and for the positive the same metal as existed in the salt experimented on. Six cells were sufficient to decompose dilute sulphuric acid slowly and dilute hydrochloric acid pretty quickly, copper electrodes being employed.

The theoretical interest of this battery lies mainly in the fact that it differs essentially from every other galvanic arrangement, inasmuch as the binary compound in solution is incapable of being decomposed either by the positive metal alone or by the two metals in conjunction; it cannot serve, in fact, as the liquid element of the circuit without the presence of another body ready to combine with one of its constituents when set free.

Grove's gas-battery is essentially different from ours if the oxygen and hydrogen condensed on the platinum plates play the part of the two metals; but it closely resembles ours if hydrogen acts the part of the positive and platinum that of the negative metal; the dilute sulphuric acid, a hydrogen compound, will then be decomposed on account of the simultaneous presence of the oxygen, which can combine with the liberated hydrogen. Viewed in this manner, Grove's gas-battery is only a special case of the general reaction which we have described in our previous paper; and the formula will be:—Before contact, $m\mathrm{Pt}+\mathrm{O}+\mathrm{H_2SO_4}+n\mathrm{H}$; after contact, $m\mathrm{Pt}+\mathrm{H_2O}+\mathrm{H_2SO_4}+(n-2)\mathrm{H}$.

The practical interest of our arrangement lies in the fact that it is an approximation towards a constant air-battery. Should it ever come into use elsewhere than on the lecture table, it will probably be in the form of a combination of zinc and copper, with an aërated solution of zinc chloride; for that arrangement has an electromotive force six times that of the arrangement we have more particularly studied, and about three-quarters that of a Daniell's cell. The numbers representing the difference of potential between the two metals, which were actually obtained by means of an electrometer belonging to Sir William Thomson, were—

Silver and copper with deoxygenised copper nitrate	4
Ditto ditto oxygenised ditto	8 to 11
Copper and zinc with chloride of zinc	62
Ditto ditto water	68
Ditto ditto Daniell's cell	83

Chloride of zinc is preferred to the sulphate, as it offers less internal resistance, and a solution of 20 per cent is recommended as about the best conductor.* A single cell of this description is capable of decomposing dilute sulphuric or hydrochloric acid, when copper electrodes are employed. The two metals might be arranged as in a Daniell's battery; the zinc would of course require no amalgamation, and the whole might be left for weeks or months without any attention. The oxide of zinc produced generally falls to the bottom of the vessel, and may be separated whenever it is thought desirable.

The power is thus obtained at a minimum of expense, for the oxygen which combines with the zinc costs nothing. Such a battery would appear to be specially adapted to cases where the galvanic current has to be frequently broken, as in telegraphy; for at each period of rest it renews its strength by the absorption or diffusion of more oxygen from the air.

ON THE DETECTION OF ARSENIC.

By J. W. GATEHOUSE.

The following modification of Fleetmann's test, which enables arsenic to be distinguished in the presence of antimony, will be found useful and more delicate than the usual mode of working:—

Place the solution in a long test-tube, and drop in a small piece of caustic soda about the size of a pea, also a piece of aluminium about a quarter of an inch in length by one-eighth of an inch in breadth, and cover the tube

* On the authority of Mr. Herbert MacLeod.

with a piece of filtering-paper which has been moistened with solution of nitrate of silver.

If the soda has not already commenced to act with some degree of energy on the aluminium, warm gently, and set aside for a short time.

The spot of nitrate of silver will be blackened should arsenic be present, but not if antimony alone be present. Should there be some quantity of arsenic present, the whole solution also will become of a dark brown colour, leaving a stain on the tube, owing to the separation of arsenicum; but with antimony a few black flakes, settling into a heavy black precipitate, are observed, the solution remaining colourless.

With respect to the delicacy of this test, I find that 0·0075 of a grain of arsenious acid, dissolved in NaHO, and diluted with water to a bulk of 250 grains, produces, when treated as above described, a perfectly characteristic reaction on the paper, the solution, however, remaining colourless.

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PRELIMINARY NOTES ON THE

ISOLATION OF THE BITTER SUBSTANCE OF THE NUT OF THE KARAKA TREE (CORYNOCARPUS LÆVIGATA).*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

A very interesting as well as a most important investigation in any country, whether for toxicological or for scientific purposes generally, is that which has for its object the identification and examination of the particular principle to which is due those poisonous or other marked effects which may have been observed on the administration of certain of its plants or herbs, or parts of them, to the animal system.

But especially is this the case in the country we are now settling, the case of its flora being in certain respects peculiar, and in many cases greatly divergent from that of any other country we are yet acquainted with; any addition, therefore, from such a quarter to the number of active principles recognised can hardly fail to be of value, as enabling us to attain to a more comprehensive view of the whole subject of vegetable medicinals or poisons—the manner of their association with other principles or with particular orders or parts of plants—and lastly, the mode in which they operate in producing their individual effects; while there is besides the chance that any principle so isolated and identified may be more useful medicinally, and more readily administered when separated from the plant.

Altogether the subject appears to be one eminently worthy of careful attention, and I have, therefore, from time to time examined many of those plants which have come the more prominently under notice by reason of their acknowledged potency in respect of the characters stated.

The last subject of these investigations has been the kernel of the fruit of the karaka tree, which, as is pretty well known, is extremely poisonous to man if taken in an unprepared state; and though I have not yet completed it, sufficient knowledge has, I think, been arrived at to render a statement of the results so far obtained interesting.

Not having personal acquaintance with the mode in which the karaka berry is prepared as food by the natives, nor of its action as a poison, I am indebted to Mr. W. Colenso, F.L.S., for the following accurate information:—

"1. Preparation as food.—The kernels were prepared for food thus:—In the autumn a large party would go to the karaka woods on the sea-coast, which were most rigidly preserved (tabooed), to gather the fruit; this was generally done by beating them down with a long pole (hence the term, "ka haere ki te ta karaka"—the verb *ta*, to hit, or strike, sharp, short, sudden blows with a stick; the same verb is used in speaking of the operation of tattooing), after which they gathered them up into baskets. In or near the adjoining beach large pits were dug for earth-ovens, into which, when ready, the karakas were poured, and the earth banked up in the usual way. These ovens were left several hours before they were opened, generally till the next day, or even longer, when the karakas were taken out, put in baskets, laced up, and placed under water, often at the mouth of some neighbouring stream or quasi lagoon, where also they remained some time (I believe a day or two at least), for the double purpose of destroying all remains of the poisonous quality, and for the loosening and getting rid of the skin and flesh (sarcocarp) of the fruit. When they were washed clean by knocking them about pretty roughly to rid them of the outer skin, &c., taken out, spread in the sun on mats and stages, and carefully dried; and when quite dry again put up in new baskets for winter use, for feasts, for distinguished visitors, and for gifts to friendly chiefs and tribes residing inland.

"As the same karaka woods did not bear alike plentifully every year, the years of barrenness were to the tribe seasons of calamity and want, the karaka being one of their staple vegetable articles of food.

"2. The symptons attending cases of poisoning through eating the raw kernel were—violent spasms and convulsions of the whole body, in which paroxysms the arms and legs were stretched violently and rigidly out, accompanied by great flushings of heat, protusion of the eyes and tongue, and gnashing of the jaws, but unattended by vomiting (very different in appearance and result from the bite of the poisonous spider, katipo, of which I have also seen and attended several cases, which are of a much more mild type, and never fatal). I mention this as both were likely to be caused in the same locality (near the uninhabited sea-shore) and season, and at first by a tyro might be mistaken. Unless speedily attended to, the poisoning by karaka quickly proved fatal; and even in those few cases in which I have known natives to recover, very likely it was more owing to the small quantity of the poison received into the system, than to the means used as *internal* remedies. As the sufferers were invariably little children, they were more easily dealt with; and to prevent the limbs becoming distorted, or stretched and rigid, a pit was quickly dug, into which the child was placed in a standing posture, with its arms and legs bound in their natural position, and the mouth gagged with a bit of wood to prevent the sufferer biting its own tongue; and there the child was left, buried up to its chin, until the crisis had passed by; sometimes it was also plunged repeatedly into the sea before being pitted. Fortunately the cases of karaka poisoning were but few, owing, no doubt, to the hard texture and disagreeable taste of the karaka kernel in its raw state; very much fewer than those arising from the eating of the sweet fruit of the tutu *(Coriaria)*, which latter, however, were more easily managed by the natives.

"The writer well recollects having seen at Wangarei (Bream Bay), in the years 1836-9, a fine healthy youth of about twelve years of age, who had been recovered from poisoning by karaka kernels. He, however, had not been properly attended to, as to the tying of his limbs in their right position while under the influence of the poison, and he was therefore now a curious spectacle, reminding one of the instrument called a caltrops more than anything else. One leg was curved up behind to his loins, and the other bent up in front with the foot outward; one arm inclined behind his shoulder, and the other slightly bent and extended forwards; and all, as to muscles, inflexibly rigid. He could do nothing, not even turn himself as he lay, nor drive off the sand-flies (which were there in legions) from feasting on his naked body, nor scratch himself when itching, nor put any food to his mouth. He was the only child of his parents, who, fortunately for him,

* Read before the Wellington Philosophical Society.

were both alive and took great care of him, turning and shifting his position very often by day and night, as, from his body not evenly resting, he could not possibly remain long in one position. When not asleep he was laughing (if not eating), and greatly enjoyed his being so placed that he could see the children at play, in which he always encouraged them by his voice, often seeming the merriest of the village. I frequently sat by his side during my visits, to talk with him, and to drive away the tormenting sandflies, which he would beg me to do. His skin was remarkably fine and ruddy—I might call it pretty—being wholly without eruption, blemish, or scar; his teeth pearly white, and voice and laugh regularly strong, hearty, and ringing. His eyes were very brilliant and of an intelligent cast; but in conversing with him I always thought his intellect was not so sharp (or developed) as ordinarily that of Maori boys of his age."

This interesting account discloses the fearful nature of the poison of the karaka nut, and also that the Maoris employ two distinct processes—baking and washing—in their mode of preparation of this article for food; but it cannot be gathered therefrom whether both processes are necessary for the removal of the poison from the kernel, and if not which is the essential one.

It will be noticed that the kernel only is spoken of as being poisonous, the fruit which surrounds it in its natural and ripened state being, as is well known, wholesome and pleasant, though not powerfully flavoured.

In pursuance of my object, therefore, I gathered a quantity of the kernels from which the fruit had completely rotted off, and after removing the woody husk I bruised them very finely, and put part to bake at a temperature of 212° for four hours, when it appeared their bitter flavour was destroyed.

The other part I steeped in successive quantities of cold water for two days. The steep-water separated from the bruised nut contained a great variety of substances, those positively identified therein being approximately in the order of their relative abundance, as follows:—Vegetable albumen (emulsion), casein (legumin), grape sugar, gum, a bitter substance, and a tasteless essential oil, which latter floated in greater part on its surface. The solid insoluble part of the nut left after the successive additions and abstractions of water was nearly tasteless, and completely devoid of all *bitterness*, and showed a resemblance in chemical composition to the insoluble part of hazel nuts.

The competence of either of the processes used by the Maoris (baking or washing) in the preparation of the nut, for the decomposition or removal of the bitter part of it, being thus shown, it naturally occurred to me that this bitter might be the poisonous part of the nut. I therefore made the isolation of this principle for the present my first object.

The bitter part in question was soon found to be capable of absorption by animal charcoal, and of removal therefrom by hot alcohol. I therefore took advantage of this department to obtain it in a pure state for examination. The details of this process are as follows:—

The kernels are well crushed and triturated with successive quantities of water (cold) till their bitter taste is gone. The solutions thus obtained are rendered distinctly acid to the taste by acetic acid; by which the casein and emulsion present are precipitated, and the filtrate therefrom agitated with animal charcoal till the bitter substance is removed. The charcoal is then collected and mixed with boiling alcohol, and the pure alcoholic solution of the bitter substance thus obtained is allowed to remain for two or three days at common temperatures, when the bitter part crystallises out in beautifully radiating acicular forms.

The characters of these crystals are as follows:—Intensely bitter; colour, white; lustre, pearly; feebly acid; at 212° F. melts; gives a dark rose colouration with warm sulphuric acid; soluble in hot water, and feebly so in cold water; soluble in alcohol, also in hydrochloric and acetic acids; soluble in ammonia and potash; insoluble in ether and chloroform; does not give any precipitate with tannic acid, nor with potasso-iodide of mercury, nor potasso-sulphocyanide of zinc; does not contain nitrogen.

The evidence as submitted above shows that the principle is not of an alkaloidal nature.

Its deportment with sulphate of copper and potash is strikingly similar to that of digitaline to the same tests. Both give green precipitates of a tint very similar to arsenite of copper. This property of either of these vegetable principles to give green precipitates with copper under these circumstances seems characteristic of them, as, among the numerous substances the most likely of any I know to give this reaction, not one has, on experiment, been ascertained to deport itself in this manner. Thus either of these principles is readily distinguishable in this way from picrotoxia, resins generally (including common resin), soaps, gums, and the bitter principle of *Phormium tenax*.

The green precipitates formed in this way by the bitter of the karaka and digitaline respectively are, however, readily distinguished from each other by subjecting them to a rise of temperature (120° F. to 212° F.); that containing the digitaline is unaffected, while the other precipitate speedily changes its colour to yellow, the copper being reduced to the suboxide, as if grape sugar were present. Further, if the proportion of the karaka bitter to the copper and potash is not properly adjusted, reduction commences at once.

It appears, however, that if the solution of digitaline is boiled with acid prior to the mixing with copper and potash, a great reduction of the copper will take place on raising their temperature to 200° F.

Taking all these facts into consideration, I am inclined to believe that the bitter of the karaka nut is a glucoside, and that digitaline falls into the same class, though I have not known this character imputed to it before.

An appropriate name for this bitter principle of the karaka will be, I think, *karakine*, and this name, therefore, I propose to give it.

Having failed, after a careful examination of the nut for vegetable alkaloids, to find any principle having the characters of these bodies, I conclude that the bitter substance here treated of (karakine) is the poisonous part of it; but not having sufficient of this principle separated to allow of a proper trial of its effects upon the animal system, I am unable to confirm or disprove the correctness of these surmises, but I hope at an early date to be able to supplement this paper by a statement of results of experiments undertaken to settle the question.

As being connected with this subject I may state, in conclusion, that the inner bark of the tree is also bitter, probably from the presence of karakine. The outer bark is not bitter, but astringent from the presence of tannin, while the sap, the wood, and the leaf (which is, I hear, wholesome to cattle) taste sweet (sugar), with not the least bitterness. These observations were taken in July.

OBSERVATIONS ON THE DURATION AND MULTIPLE CHARACTER OF FLASHES OF LIGHTNING.

By OGDEN N. ROOD,
Professor of Physics in Columbia College.

Arago has classified the different forms of lightning under three heads:—1st, linear zigzag flashes; 2nd, flashes appearing as a broadly diffused light (sheet lightning, heat lightning); and lastly, the rarely occurring discharges which are seen as slowly moving balls of fire.* That the first form is due to the production in the atmo-

* See Dr. Ernst E. Schmids' "Lehrbuch der Meteorologie;" Leipzic, 1860, p. 781.

sphere of a gigantic electric spark has since Franklin's time been disputed by no one, and, as far as I can ascertain, the majority of physicists and meteorologists *suppose* that flashes of the second form are due to the same cause, their light being seen either by transmission through or reflection from the clouds.

Before detailing my own observations on this matter, I wish briefly to mention the results thus far obtained by others. Among the most important of them is an experiment by Dove, who, in 1835, during a thunder-storm, was able, by the help of a revolving disc with coloured sectors, to satisfy himself that single flashes of lightning often consisted of a number of apparently instantaneous discharges.* Arago suggested for the determination of the duration of the flash the use of a rotating circular disc, painted with a hundred black and white sectors. He supposed that, from the appearance presented by the disc when illuminated by the flash, the observer would be able to ascertain its duration.† Wheatstone, with a revolving disc of this kind, found the duration of the flash too short for measurement, and set it as less than $\frac{1}{1000}$ of a second. Casselmann, in 1847, noticed that single flashes of lightning sometimes moved the index of the telegraphic apparatus forward over two, four, or even six letters, and argued thence the multiple character of the discharge, which indeed had previously been observed by Dove.‡ Faraday, in 1857, noticed that the duration of some flashes of lightning *seemed* to him fully as great as a second, if not more, and attempted to explain this by a phosphorescence of the portion of the cloud traversed by the flash.|| C. Decharme, at Angers, in 1868, while a distant storm was raging, saw the heavens from time to time illuminated by a light which *seemed* to last from a half to an entire second.§ In these last two observations no apparatus was used for actual measurement. To the above, I may add a rough measurement of the duration of the lightning flash, made by myself in 1870, with an apparatus differing from that employed by other observers, the interval of time obtained being often $\frac{1}{500}$ of a second, though sometimes it was considerably smaller.¶ Finally, after finishing the observations and measurements detailed in the present paper, I saw in *Nature*, July 25th, 1872, an account of some experiments which were made by B. W. Smith, with the aid of a "colour-top," or after the method of Dove. Mr. Smith notices the fact that the duration of the flashes sometimes seem to be prolonged by an action, which he, like Faraday, attributes to a phosphorescence of the cloud in which the discharge takes place. These observations appear at first sight to be more or less contradictory, but with the aid of the more complete set of results recently obtained by myself it will be easy to bring them into harmony.

New Observations.

(1). Immediately after my own experiment I arranged a small train of toothed wheels driven by a spring, so that it should be capable of rotating a circular pasteboard disc which was provided with four *open* sectors of 3° each. This apparatus was constantly near me ready for use, but an entire year elapsed before an opportunity occurred. I noticed then, upon one occasion, about midnight, that my room was from time to time illuminated by lightning-flashes, whose duration seemed as great as an entire second; and upon making an examination with the rotation apparatus, it was found that each flash consisted of a considerable number of isolated and apparently instantaneous electric discharges, the interval between the components being so small that to the naked eye they constituted a continuous act. The lightning was of the second form, and, judging from the accompanying thunder, was not very distant; but it soon ceased, so that I was not able to gain any further information.

(2). The next observations were made late one evening in last June. The storm was at a greater distance, and, as before, the clouds were illuminated by unseen flashes. Each flash again consisted of a considerable number of apparently instantaneous discharges, perhaps about ten; but the total duration of the compound flash was so great that, with the lowest practicable rates of rotation, I was entirely unable to form even a rough estimate of the interval of time involved. The storm allowed me no time for the study of the components of the flashes.

(3). During the following month, at about the same hour in the night, I again observed, near the horizon, clouds illuminated by a more distant storm. The multiple flashes were once more noticed, and when the disc revolved at rates of five to ten revolutions per second, the light from the four sectors was quite often drawn out into a circular streak, which extended around its entire circumference, showing a steady and continuous duration of some of the components for at least $\frac{1}{20}$ to $\frac{1}{40}$ of a second. These streaks were observed quite often and with perfect distinctness, though the figures just given are to be considered only rude approximations. Mingled with these, if not actually constituting a portion of them, were apparently instantaneously flashes. The total duration of the act was so great as again to defeat attempts at measurement.

(4). A thunder-storm occurring at 2.30 a.m., on July 30th, gave a better opportunity. The observations, like the preceding, were made at Peacedale, R.I., and the majority of the electrical flashes were so distant that the accompanying thunder was heard only occasionally, and, as before, the flashes were not seen directly, but by transmission. In spite of this, however, many of them were very vivid, and much rain fell during the time occupied by the observations. Previously I had arranged the apparatus for the measurement of greater intervals of time, by attaching to one of the axes a disc with a single open sector, which could be rotated at quite low rates, the terminal axis being provided with a fan. When this disc was revolving at the rate of 2·04 turns per second, the open sector was several times observed to make at least two complete revolutions during a single flash, which gave a total duration for the act in those cases of about one second; and I may add that after the completion of the experiments described below, durations of the total act were observed, even with the naked eye, which must have been as great as a second, and the light illuminating the room was noticed during the continuance to flicker twice or thrice. The total duration was, however, quite variable, and often amounted only to a small fraction of a second.

With a disc having only a single narrow, open sector, and making from 12 to 15 revolutions per second, the multiple character of the flashes was then studied. The flash consisted of a considerable number of isolated electrical charges, which sometimes were executed with so much regularity as apparently to cause the disc to rotate backward, with a slow motion, through 30° or 40°, the cause being analogous to that involved in the phenomena of the stroboscopic discs. Several times, also, instead of seeing the sector single, I noticed that it had a form approximating to that of the letter X or V, which evidently was due to the circumstance that almost involuntarily my eyes had glanced from one side of the disc to the other, thus giving rise to a combination of distinct visual impressions.

Next, for the purpose of examining the individual constituents of the flash, I placed on the terminal axis a circular disc, each quadrant containing a square opening of about 5°; and when this was revolving eleven times in a second, sometimes the flash was seen to consist of a small number (three to six) of apparently instantaneous discharges, the form of the square not being at all distorted. The same was afterward noticed with a velocity as high as 22 revolutions per second, and if the areas of

* *Pog. Ann.*, 1835, p. 371.
† Becquerel, "Traité de l'Electricité et du Magnetisme," vol. vi., pp. 128, 129. Paris, 1840.
‡ *Fortschritte der Physik* for 1847, p. 668.
|| *Phil. Mag.*, IV., vol. xiii., p. 506.
§ *Fortschritte der Physik*, vol. xxiv., p. 644.
¶ *Amer. Journ. of Scicnee and Arts*, III., vol. i., Jan., 1871.

the squares had been doubled this could not have escaped my attention, but as in many cases nothing of the kind was seen, it follows that the duration of the apparently instantaneous constituents was less than about $\frac{1}{1000}$ of a second.

On the other hand, sometimes the continuous duration of the constituents was such that the whole circumference of the disc was surrounded by a bright or faint ring of light, according to the original luminosity of the flash, which gave a duration for the continuous act at least as great as $\frac{1}{24}$ of a second. Quite often I was able to notice that these continuous discharges did not make up all the elements of the flash, but that they were terminated by an isolated and instantaneous discharge.

(5). The last set of observations were made at Stockbridge, Mass., on the evening of August 25, 1872. The thunder was heard quite loudly, and direct zigzag flashes were occasionally seen; rain also fell. The disc employed on this occasion had only *one* square opening, the sides of which were 7 m.m. (corresponding to about 12°), these dimensions having finally been found preferable. The rate of rotation was kept nearly constant by winding up.

The flashes were usually multiple, and the duration of the components was often or generally quite long, being as great as $\frac{1}{20}$ of a second, if not longer; the brilliancy of the ring of light was considerable, and showed no signs of falling off throughout its whole extent. It was again noticed that when the duration of the earlier components had thus been considerable, the last act (or certain acts) were instantaneous. Eight or ten times it was fairly noticed that the components of certain flashes were to all appearance instantaneous, there being no distortion in the shape of the square. If its area had been increased by one-half this could not have escaped my attention, and would have implied a duration of $\frac{1}{200}$ of a second. A number of uncertain observations were made, leading to a duration of the components, in some cases, of from $\frac{1}{300}$ to $\frac{1}{600}$ of a second, and, finally, in two cases the breadth of the square was distinctly doubled, giving a duration of about $\frac{1}{600}$ of a second.

To the above I must add several observations made by the naked eye on *normal zigzag* flashes, when on five or six occasions the duration of the direct flash was estimated at not less than one second, the light seeming to pour steadily in a stream from the cloud to the earth. They correspond to that of Faraday, referred to in the earlier part of this article.

It is evident from the foregoing that the nature of the lightning discharge is more complicated than has generally been supposed; it is usually, if not always, multiple in character, and the duration of the isolated constituents varies very much, ranging from intervals of time shorter than $\frac{1}{1000}$ of a second up to others at least as great as $\frac{1}{20}$ of a second, and furthermore, what is singular, a variety of this kind may sometimes be found in the components of a *single* flash. The long durations of certain constituents of the flash induced me afterward to make some experiments with a view of ascertaining the cause of this singular and unexpected phenomenon; and although the results are negative in character, still it may not be amiss briefly to mention them. I constructed a glass tube similar to those used for studying the spectral lines of rarefied gases, and having connected it with a mercurial air-pump, rarefied the ordinary air contained in it. A Leyden jar, with a coating of 738 square centimetres, was connected with the tube, and a spark micrometer was introduced into the circuit, so as to interrupt it, and thus to cause the jar fairly to charge and discharge itself, as otherwise the prolonged discharges of the induction-coil made their appearance. The tube was placed in front of the rotation apparatus used by me in investigating the electric spark, and its appearance studied at tensions from 1 m.m. upward, till the resistance became so great as to cut off the discharge. In every case the light appeared to be instantaneous, that is, its duration was so small as to preclude the idea of its affording an explanation of the long intervals occurring in the case of lightning flashes. Of course, in all these experiments, the actual rate of the mirror was quite low. I then repeated the same experiment with the vapour of water, at a tension of about 15 m.m., with the same result.

Afterward a jet of steam was directed across the path of the electric spark in the free air, with a similar negative result. Finally, thinking that possibly the rain might in some way be concerned in the production of the prolonged durations, while sparks 10 to 15 m.m. in length, obtained from a smaller jar, were traversing the ordinary atmosphere, fine watery spray was directed across their path by the use of an "atomiser," without sensibly increasing their duration. These experiments may be explained by the greater volume of the atmospheric electricity, but suggest, on the other hand, the possibility of a real prolongation of some of the constituents of the flash.

Recently the spectrum furnished by flashes of lightning has been examined by Dr. H. Vogel.* A number of lines were identified, as also occurring in the spectrum of the electric spark in the ordinary atmosphere; but what is remarkable, it was found that sometimes the spectra consisted of bright lines on a dark ground, while at others the bright lines were traced on a less bright continuous spectrum, and, finally, sometimes a continuous spectrum destitute of lines was obtained. The discharges were principally of the form known as sheet lightning. I consider it probable that the continuous spectra destitute of lines, observed by him, were due to the *prolonged* constituents mentioned in this paper, and the occurrence of bright lines on a less bright ground I would refer to cases when instantaneous and prolonged constituents were mingled as noticed by myself; the normal spectrum of bright lines on a dark ground, finally, being produced by flashes more nearly instantaneous. Since writing the above I find that Wüllner, in No. 11 of *Pog. Ann.* for 1872, has shown that, in rarefied air, instantaneous sparks give a spectrum consisting of *lines*, while the prolonged constituent of the spark of an induction-coil often produces a *banded* spectrum, which under certain circumstances approximates to one that is continuous.

It will be noticed, that while making observations No. 5 I was in the area occupied by the storm, in No. 4 on its outer edge, in No. 1 out beyond the edge, and in No. 3 the storm was quite distant. Yet in all these cases the character of the lightning, as far as could be observed, was quite identical, furnishing, as it seems to me, argument in support of the hypothesis that zigzag lightning, heat and sheet lightning, &c., are really identical, being in point of fact due to the same cause, but viewed under different conditions.

Best Form of Apparatus for the Study of Lightning Flashes.

From the contents of this article it will be seen that additional observations are still desirable, and hence I wish to describe more definitely the apparatus which after many trials answered best, as well as to suggest one of a more perfect form. At the outset I found it necessary to discard the plan of viewing a figure painted on an opaque disc, which seems to be the only one which had occurred to other physicists, its indications being uncertain, and the loss of light so great that it was impossible to observe even the *presence* of the less prominent constituents of the flash. It is advisable, then, to use a black or *grey* opaque disc, about 100 m.m. in diameter, with an *open* sector, and, as has been shown in the present article, this is the only mode by which, thus far, actual measurements of the duration have been obtained. The multiple character of the flash renders it unadvisable to use more than one sector. The best form for the shortest and longest durations is that of a square, with sides of from 7 to 10 m.m.; for medium durations the same form can be retained with larger dimensions, and for examining the multiple character of the flashes simply a long narrow sector of 1° or 2°

* *Pog. Ann.*, 1871, No. 8, p. 653.

is preferable. The use of the disc micrometer, described by me in another place, I do not consider practicable with storms in our latitudes, though the frequency of the flashes in the Tropics might render possible its employment. A spring rotation apparatus, on account of portability, may be used, being so contrived as to admit of rates from one revolution up to twenty or thirty per second. This should be provided with some contrivance by which the observer might always be able to ascertain to what extent the clock-work at the moment had run down, so that the rate of the disc's rotation could afterward be found, without at the time interrupting the observations. A simple plan is to wind on the cylindrical portion of the key a string, which passes downward through the base of the instrument, knots being tied on it so as to indicate the number of turns already made by the slowest wheel.

The following is a more elaborate form, with which more accurate results could be attained, and which probably would reveal details quite beyond the reach of the simpler apparatus. A circular disc of the kind just mentioned is to be set in rotation by clock-work run by a weight; an image of the disc, of the natural size, is to be formed on a vertical plate of ground glass by an achromatic lens of 7 or 8 inches focus and of large aperture ("portrait combination" from a photographic camera). An opaque circular screen is to be placed around the edge of the disc so as to cut off all stray light, which I found in my experiments very annoying. The observer placed behind the ground glass will measure simply with a pair of compasses the length, &c., of the streaks, in the manner described by me in another place,* and the difficulty of accommodating the eyes for the image will in great part vanish, from the circumstance that the hands will be resting on the ground glass where the images are expected. It is scarcely necessary to add that to use this or any method successfully will require some previous training, which I think could best be obtained by a repetition of the experiments and measurements described by me in a former number of this journal.*—*Amer. Journ. of Science and Arts.*

* *Amer. Journ. of Science and Arts*, III., vol. iv., Oct., 1872.

NOTICES OF BOOKS.

Annual Report of the Board of Health to the General Assembly of Louisiana. New Orleans. 1873.

Although the Chemical News is not a medical paper, we feel deeply interested in the progress of sanitary science. The relative value of disinfectants, the purification of air and water, the treatment of town sewage, and the consumption of smoke, are questions into which we always feel it our duty to enter, and which few, if any, of our readers will deem irrelevant.

On these subjects the volume before us supplies some interesting information. New Orleans is a city of evil report in a sanitary point of view, whence the results obtained there are all the more valuable. The favourite "disinfectant and deodorant" appears to be a mixture of the chlorides of zinc and iron. It is a by-product of a method for recovering tin from tinners' waste. The scraps are dissolved in hydrochloric acid, and the tin precipitated by the immersion of metallic zinc. The residual solution contains, we are told, about 6½ grs. of chloride of zinc, and 5 grs. of ferrous chloride, per pint, and is sold wholesale in New Orleans at 50 cents per gallon. The iron is converted into perchloride by treatment with nitrate of soda and hot hydrochloric acid, which enhances its disinfecting powers. From a pint to a quart will, as we are told, "perfectly deodorise ordinary vaults (cesspools ?), and will not require repetition in less than ten to fifteen days." It is said that these metallic salts destroy totally and immediately all sulphuretted hydrogen, sulphide of ammonium, and phosphuretted hydrogen, the chief offensive and deleterious emanations from vaults, &c.

That sulphuretted and phosphuretted hydrogen are offensive and deleterious we fully admit; but that they are the chief source of danger in sewage gases is, in our opinion, by no means demonstrated. Phosphide of hydrogen is by no means an ordinary result of the spontaneous decomposition of animal and vegetable refuse, and certain phenomena once ascribed to its evolution, such as the luminosity of the glowworm and of touch-wood, have been found to be of quite another nature.

Lime, as a disinfectant, is not recommended, as matters in a state of decomposition are ordinarily alkaline, a point which we commend to the authors of certain sewage schemes at home.

In the especial report of Dr. Perry, the chemist to the Board, we find notice of certain other disinfectants, such as Terry's zinc-iron mixture, containing 14 per cent of copperas, 20 per cent of crude carbolic acid, a slight sediment of peroxide of iron, with a trace of sulphate of zinc. Bromo-chloralum is chiefly chloride of aluminium, with small quantities of the chlorides of calcium, magnesium, sodium, and iron, and about 30 grains of bromine per pint in combination with sodium. It prevents decomposition in animal fluids, but is useless for destroying the sulphur compounds.

Egyptian disinfecting powder (Terry's) consists of clay dried and powdered, and mixed with 2·5 per cent of carbolic acid and 0·7 of sesquioxide of iron. It is of little value.

In case of yellow fever, carbolic acid is exclusively recommended. All bedding and clothing are to be steeped in a dilute solution of the pure acid, which is also to be thrown in a fine spray upon the walls, ceilings, floors, and furniture. Experiments have been undertaken to determine whether the odour of carbolic acid, used as a disinfectant on board ships, would injure a cargo of sugar. After long exposure to the vapour, no difference could be recognised either in the smell, taste, or colour of the sugar.

New Orleans cannot be congratulated on its sanitary arrangements. The city is not sewered. "From three-fourths of the houses the solid offal is removed pretty regularly by carts; that from the other fourth is thrown into the streets and gutters. All the liquid and semi-liquid refuse, slops, &c., are allowed to run into the gutters, in seven-eighths of which they remain." A sample of the mud from the gutters, weighing 1000 grs., and containing 24 per cent of solid matter, on evaporation yielded 0·015 per cent of free ammonia, and on ignition with soda lime gave a further amount of nitrogen = 0·88 ammonia. The subsoil must be frightfully polluted. The water from a shallow well not now used for drinking purposes gave, per litre, 604 milligrms. of ammonia and 456 of nitric acid. The air contained in one instance as much as 360 grms. of albumenoid ammonia per million cubic metres. The most unsavoury locality in London, according to the analysis of Dr. R. A. Smith, quoted for comparison, showed only 271 grms. Having regard to these circumstances, and to the heat of the climate (the mean temperature being 83·85° F. for July, 84·45° for August, and 81·5° for September, eminently calculated to promote brisk decomposition among the accumulations of organic refuse), we can only express surprise that the annual mortality does not exceed the recorded proportion of 31·98 per 1000 of the entire population.

It is satisfactory to learn that the determinations of free and albumenoid ammonia, both in water and air, are performed by the process of Wanklyn and Chapman, which may now fairly be said to have established itself over the whole civilised world.

Concerning the diffusion of fœcal matters in the soil, we find statements apparently, at least, contradictory. Thus we are informed that "waters of wells in the near vicinity of privy-vaults are not perceptibly affected by them." This view seems somewhat strange in connection

with the highly polluted state of the wells to which we have referred above. As far as we can judge from the facts adduced, sewage irrigation would be a more serious mistake in the climate of New Orleans than it is in England. The only choice before the citizens, if they wish to improve their sanitary condition, is, either the dry-closet system, or, if sewers are preferred, the most efficient mode of precipitation. We shall await with interest the improvements which they will doubtless ere long introduce, and shall look forward to the results of their experience.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Société Chimique de Paris, No. 7, 1873.

Note on an Aspirator.—M. H. Lasne.—If we allow water to flow in a tube whose diameter increases continuously, the same mass of water will traverse in a given time each of the two extreme sections; but from the first to the second it loses a part of its speed. This loss is due to a force which resists the movement of the liquid, and if we neglect friction there remains the difference of the pressures exerted upon the two sections considered. The pressure, therefore, must vary from one section to another, being weakest where the speed is greatest, *i.e.*, in the narrowest section. If the larger opening of the divergent tube opens to the air, the water in it is subject to atmospheric pressure, and if we cause the narrowest part to communicate with a barometer-tube the mercury rises to a certain height. By adapting suitably the ratio of the two sections, the mercury may be made to rise to a height which only differs from that of the barometer by the tension of watery vapour at the temperature of the experiment. On placing the apparatus in connection with a receiver under pressure higher than it can support, air is drawn out; the pressure in the receiver falls until equilibrium is established. The arrangement of the apparatus cannot be understood without diagrams. The author considers that, without professing to replace the air-pump, it will be very convenient for a number of operations which it may be desirable to perform under reduced pressure, especially for distillations and evaporations at low temperatures, for which the air-pump is not well adapted.

On the Sulphovinates.—M. Berthelot.—(1). Reaction of sulphuric acid upon alcohol.—This gives rise to widely different products according to the temperature. If the two bodies are previously cooled and gradually mixed, avoiding any rise of heat, no reaction takes place at first. On prolonged contact there is formed a peculiar sulphovinic acid, whose salts differ from the ordinary sulphovinates, into which they may be transformed by boiling. Concentrated acid and absolute alcohol mixed in equal volumes, and without special precautions, give rise to a strong disengagement of heat, and yield ordinary ethyl-sulphuric acid. The yield varies according to the manner in which the mixture takes place, *i.e.*, according to the local rise of temperature, and the relative proportions which come in contact where the acid and the alcohol are poured together. For instance, on mixing without precaution 1 part by weight of stray acid and 5 of alcohol, the author found at the end of one hour 10 per cent of the acid had become sulphovinic acid, and after twenty-four hours 26 per cent. On carefully mixing 1 part by weight of strong acid and 2 of alcohol, the amount etherified was, after one hour, nearly nothing, and scarcely increased by a few hundredths in twenty-four hours, although the excess of acid in comparison with the former experiment should have promoted combination. In all cases the action gradually reaches a fixed limit which it cannot pass. Thus, strong acid and absolute alcohol at common temperatures, $(SO_4H+\frac{1}{3}HO)+C_4H_6O_2$, yielded, for every 100 parts of sulphuric acid, the following quantities of sulphovinic acid:—

After 40 hours	56	per cent.
" 90 "	59	"
" 147 days	58·8	"

which limit was not exceeded. The reaction is accelerated by heat. If the temperature is raised to 100° in four hours, we obtain 56 per cent of ethyl-sulphuric acid. The application of heat must not be prolonged too much, as after exposing the mixture to 100° for 10 hours we find only 42 per cent of ethyl-sulphuric acid. This retrograde action is due to the slow formation of ether at the expense of the ethyl-sulphuric acid, which tends to reproduce sulphuric acid. The production of ether becomes very abundant if the temperature is raised to 145°. Between 160° and 170° ethylene is formed; it is, therefore, needful to raise the temperature to 100°, and maintain it for a very short time in order to secure the immediate formation of ethyl-sulphuric acid in its most stable form, but a prolongation of that heat, as well as a higher rise, must be avoided.

Reaction of Water on Sulphovinic Acid and on its Salts.—This action is first indicated by the fact that the formation of sulphovinic acid does not pass the limit of 59 per cent when equal equivalents of sulphuric acid and alcohol are in contact. This limit is due to the presence of water—the product of etherification—which decomposes pure sulphovinic acid in an inverse manner, the decomposition stopping at the same limit as the reciprocal combination. Between these four bodies—alcohol, sulphuric acid, sulphovinic acid, and water—there is formed a certain equilibrium (as in the formation of other compound ethers), though the limit is not always identical, since the bibasic organic acids, *e.g.*, oxalic, succinic, and tartaric, form at once the compounds, a neutral and an acid ether. Nevertheless, the general phenomena remain similar. The proportions of the equilibrium are not affected by temperature unless new compounds are produced, such as ordinary ether and olefiant gas. In fact the limit of the reaction being 59 per cent of ethyl-sulphuric acid in the cold, and at the end of several weeks; the author finds, on the other hand, 56 per cent at 100°, after the lapse of a few hours. The limit of the equilibrium is equally modified by the proportions of the four components. In course of time, water especially decomposes sulphovinic acid, and the presence of an excess of water at the outset lowers the limit of etherification, and delays the combination as shown by the following figures:—

Nature of the Mixture.

(1). $SO_4H+C_5H_6O_2+\frac{1}{3}HO$
(2). $SO_4H+C_4H_6O_2+1\frac{1}{3}HO$

	40 hours.	90 hours.	20 days.	147 days.
(1).	56·0	57·4	59·0	58·8
(2).	13·2	21·2	41·2	54·8

Alcohol containing 25 per cent of water yielded only 8 per cent of sulphovinic acid in a month. Similarly if water be added to sulphovinic acid or to one of its salts, there will ensue decomposition and reproduction of alcohol and acid, slowly in the cold, but rapidly at 100°. The decomposition of the sulphovinates is less rapid than that of free sulphovinic acid. Hence, they can be evaporated to crystallisation without destruction, but cannot be kept for any length of time in solution. The decomposition of dissolved sulphovinates when once set up goes on accelerating, since the sulphuric acid liberated seizes its equivalent of the base, and sets free a portion of the sulphovinic acid. During the destruction of these salts by evaporation each equivalent of sulphovinic acid sets free two equivalents of sulphuric acid. Two more equivalents of sulphovinic acid result from the action of this sulphuric acid upon the dissolved sulphovinates. These, in turn, become 4 equivalents of sulphuric acid, and thus the reaction once set up, goes on in a geometrical progressing. Hence it is useful to keep the solutions of sulphovinates during concentration or preservation in a neutral or slightly alkaline condition by the addition of a trace of carbonate or bicarbonate of soda. All the known sulphovinates when in a solid form contain water of crystallisation, and all in a longer or shorter period undergo decomposition. This alteration results from the action of the crystalline water which is eliminated by efflorescence.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 4, 1873.

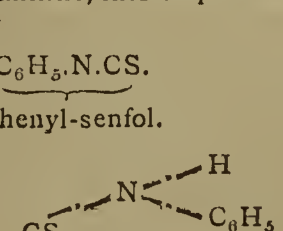
The following original papers and memoirs are contained in this number:—

Relation Existing between the Aromatic Senfols (Essential Oil of Mustard) and Cyanides.—W. Weith.—This monograph treats on the following subjects:—Conversion of cyanphenyl into phenyl-senfol respectively. The author's view is, that when the structure and constitution of the aromatic cyanides and senfols are mutually compared, it might be possible to convert the former into the latter, according to the formula—

$$\underbrace{R.NC}_{\text{Cyanide.}} + S = \underbrace{R.NCS.}_{\text{Phenyl-senfol.}}$$

The experimental realisation of this view is confirmed, since the author, while commencing with the phenyl series, has succeeded in converting cyan-phenyl, by the aid of aniline, into sulpho-carbanilide, according to the following formulæ:—

$$\underbrace{C_6H_5.NC}_{\text{Cyan-phenyl.}} + S = \underbrace{C_6H_5.N.CS.}_{\text{Phenyl-senfol.}}$$

$$\underbrace{C_6H_5.NCS}_{\text{Phenyl-senfol.}} + \underbrace{C_6H_5.NH_2}_{\text{Aniline.}} =$$ 

The subjects further further treated of are:—Preparation of sulpho-carbotoluide from cyan-tolyl. By the substitution of toluidine for aniline in the reaction just alluded to, sulpho-carbotoluide is obtained with all its characteristic properties; benzo-nitrile and sulphur gave

no positive result. Desulphuration (*entschwefelung*) of phenyl-senfol is obtained at from 180° to 200° by the aid of finely-divided metallic copper, the result being the formation of benzo-nitrile, which appears to be a secondary product, since it would appear that cyan-phenyl is first formed, a fact confirmed by the conversion of the latter into benzo-nitrile by heating the cyan-phenyl in a sealed tube at 220°.

Phenyl-Propyl-Alcohol.—R. Fittig.

Arseniuretted Hydrogen.—J. V. Janowsky.—After briefly enumerating the well-known properties of this poisonous gas, and alluding to its instability, the author records his experiments with the gas on terchloride of phosphorus, which results in the formation of phosphor-arsenic, (PAs), a solid body decomposed by water, insoluble in alcohol, ether, and chloroform, and slightly soluble in sulphide of carbon. Sulphuric and hydrochloric acids do not act upon this body at the ordinary temperature; concentrated nitric acid oxidises it, giving rise to the formation of arsenic and phosphoric acid. Solutions of caustic alkalies and of caustic baryta decompose the phospho-arsenic, even at the ordinary temperature, with formation of phosphuretted and arseniuretted hydrogen, phosphorous and arsenious acids, and metallic arsenic. When ignited in the air, the phosphor-arsenic yields arsenious and phosphoric acids. The product of the decomposition of the compound just alluded to and of water has the following composition ($As_3P_2O_2$) in 100 parts:—As, 70·53; P, 19·44; O, 10·03. The concluding portion of this paper treats on the dissociation of arseniuretted hydrogen when in contact with terchloride of arsenic, whereby metallic arsenic and hydrochloric acid are formed—$AsCl_3+AsH_3=2As+3HCl$.

Combinations of the Aldehydes and Alcohols with the Aromatic Hydrocarbons.—A. Baeyer.—The fourth portion of a monograph on this subject, this instalment being divided into the following sections:—Formaldehyde and aromatic hydrocarbons, viz., benzol, diphenylmethan; substitution products of aldehyde and the aromatic hydrocarbons; chloral and benzol; dichlor-aldehyde and benzol; toluol and chloral; monochlor-benzol and chloral; monobrom-benzol and chloral; benzol and bromal; alcohols and aromatic hydrocarbons.

On some Naphthaline Compounds.—J. Grabowski.

Action of Sulphuric Acid upon Chloral.—J. Grabowski.—After briefly referring to the researches of other scientific chemists on this subject, the author observes that chloral readily forms a compound with sulphuric acid, the formula being $C_8H_6Cl_{12}S_2O_{11}$. This body is not decomposed by cold water, but by warm water it is converted into chloral, or products of its decomposition, and in sulphuric acid. The sulpho-chloral is readily soluble in alcohol, but then, also, decomposition sets in. In ether the sulpho-chloral is soluble without undergoing any decomposition.

Contribution to our Knowledge of Monochlor-Sulphuric Acid.—M. Müller.—This essay, elucidated by a large number of complex formulæ, records the results of the author's researches as compared with those of Williamson and others on this subject.

Lecture Experiments to Illustrate Combustion.—K. Heumann.

Researches on some Oxidising and Reducing Agents.—J. Thomsen.—This monograph, abridged from the author's more extensive pamphlet on this subject, treats on the following substances, viz.,—Reducing agents, sulphurous acid, protosulphate of iron, protochloride of iron, and protochloride of zinc; oxidising agents—chlorine and bromine, hypochlorous acid, permanganate of potassa, peroxide of manganese, chromic acid, and peroxide of hydrogen.

On Mutual Constancy of Affinity (Gemeinschaftliche Affinitüts Constante).—J. Thomsen.

On Aconic Acid.—F. Meilly.—The acid alluded to was first discovered by Kekulé, and prepared from bibrom-pyrotartaric according to the following formula:—$C_5H_6Br_2O_4-2HBr=C_5H_4O_4$. The author describes at some length the soda, baryta, zinc, copper, and silver salts of this acid. Most of these salts are crystalline, and soluble in water. The greater portion of this essay—elucidated by lengthy and complex formulæ—is devoted to the description of the researches on the aconic acid methyl-ether, or methyl-aconic acid, and on the action of acetic anhydride and aconic acid.

Action of Oxalic Acid Ethyl Ether upon Naphthylamine.—M. Ballo.—This paper treats chiefly on naphthyl-oxaminic acid and its salts.

Composition of Suint.—E. Schultze.—The continuation of an essay on this subject. This part treats chiefly on isocholesterine, $C_{26}H_{44}O$, and derivatives thereof.

On Aceto-Cinnamon, and some other Combinations Formed by the Dry Distillation of a Mixture of Cinnamate of Lime and the Acetate of that Base.—C. Engler and A. Leist.

A More Extended and New Method for the Preparation of Ketons.—C. Engler and A. Leist.

Contribution to the History of the Violet-Coloured Rosaniline Derivatives.—Dr. A. W. Hofmann.—In this paper the eminent *savant* treats on a newly-discovered substance resulting from the reaction of a mixture of benzyl-chloride and methyl-iodide upon rosaniline dissolved in methylic alcohol (pure wood-naphtha). The new compound, a beautiful crystalline body, is the iodmethylate of the tribenzylated rosaniline, $C_{42}H_{40}N_3I=C_{20}H_{16}(C_7H_7)_3N_3.CH_3I$; it is formed according to the following formula:—

$$C_{20}H_{19}N_3,H_2O+3C_7H_7Cl+CH_3I=$$
$$=C_{20}H_{16}(C_7H_7)_3N_3,CH_3I+3HCl+H_2O.$$

The new compound alluded to was discovered by Herr F. Hobrecker, at Cretfeld.

Le Moniteur Scientifique Quesneville, April, 1873.

Means of Cooling the Air, and their Application in the Arts and in Domestic Life.—M. A. Jouglet.—A lengthy and rhetorical paper, more interesting in India than in England. The various modes of reducing temperature are examined in detail. The method of compressing air in large receivers, allowing the heat thus set free to be dissipated, and then allowing the air, in resuming its original volume, to render a portion of heat latent, is declared impracticable on the large scale. Evaporation as a mode of lowering temperature seems to find more favour in the eyes of the author, though he does not attempt to deny that an atmosphere saturated with watery vapour is oppressive, and often positively dangerous, from its power of checking insensible perspiration. The use of ice is impracticable, on account of its cost. Air has been cooled by forcing it through subterranean passages; this method is not merely costly, but suspicious, since in all cities the subsoil, to unknown depths, is contaminated with sewage matters, which would certainly taint currents of air driven through such tunnels. Double walls and roofs, between which currents of air are forced to circulate over wet surfaces, have also been suggested. An arrangement of this kind, with the inner wall and ceiling of sheet-iron, would probably be successful in tropical climates. Air has been drawn down a high shaft like a chimney, in the hope that it might prove cool. It need scarcely be remarked that, in hot weather, the temperature at the utmost height of such a shaft will be but slightly below that which prevails at 10 feet from the ground. The system which the author prefers is a machine for driving a current of air through a metallic plate pierced with fine holes, over which flows continually a thin stream of water. This, he states, will cool the air without dangerously increasing its amount of vapour. The author points out the valuable results which the power of lowering temperature at will would yield in hospitals, steamboats, breweries, wine cellars, chocolate works, sugar refineries, granaries, &c.

Determination of Phosphoric Acid in Substances of Agricultural and Physiological Importance.—M. H. Joulie.—We shall give this paper in an early number.

La Revue Scientifique de la France et de l'Etranger, April 3, 1873.

Contains no original papers relating to chemistry.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3803. Baron de Malorti, Jermyn Street, and J. E. T. Woods, West Kensington, Middlesex, "An improved process for preserving fresh meats, game, fish, and vegetables."—Petition recorded December 16, 1872.

846. H. Skoines, Argyle Street, King's Cross, Middlesex, "Improvements in the manufacture of gas, and in the treatment of the residues therefrom, and in the combination of gases for the production of light and heat, and in the apparatus employed therein."—Petition recorded March 8, 1873.

1007. G. Newton, Bow, Middlesex, "An improved lubricant."—Petition recorded March 19, 1873.

1043. N. Athow, Plaskynaston, Denbighshire, "Improvements in the production of colours for dyeing, printing, and staining."—Petition recorded March 20, 1873.

1055. P. Jensen, Chancery Lane, Middlesex, "Improvements in manures."—A communication from E. J. Erichsen, Copenhagen, Denmark.—Petition recorded March 21, 1873.

1105. E. C. Vickers, Clerkenwell, Middlesex, "Improvements in the preparation and treatment of paper to be used as a substitute for leather."

1106. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the manufacture and preservation of beer, and in the treatment of yeast and wort, together with apparatus for the same."—A communication from L. Pasteur, Paris.—Petition recorded March 25, 1873.

1115. T. Maxted, Newnham, Kent, "Improvements in fuel and in the manufacture thereof."

1121. C. Roberts, F.R.C.S., Mayfair, Middlesex, "Improvements in the preparation of powders for the destruction of animal and vegetable parasites, applicable also as disinfectants and deodorisers."

1123. E. T. Moody, Templecombe, Somerset, "Improvements in the manufacture of illuminating-gas."—Petitions recorded March 26, 1873.

NOTICES TO PROCEED.

3813. A. M. Clark, Chancery Lane, Middlesex, "An improvement in artificial fuel."—A communication from E. F. Loiseau, Manch Chunk, Carbon, Penn., U.S.A.—Petition recorded December 16, 1872.

326. G. Haseltine, Southampton Buildings, London, "An improved process of converting cast-iron into steel, applicable to the manufacture of edge-tools."—A communication from T. H. Alexander, Washington, D.C., U.S.A.—Petition recorded January 28, 1873.

710. E. Metge and F. N. C. Vuibert, Boulogne-sur-Mer, France, "An improved mode or process of preserving meat."—Petition recorded February 26, 1873.
752. J. Buchanan, Hebburn, Durham, "Improvements in utilising alkali-waste in the manufacture or production of building materials."—Petition recorded March 1, 1873.
945. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the treatment of peat for fuel, and in apparatus for the same."—A communication from J. F. F. Challeton, Paris.—Petition recorded March 14, 1873.
980. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of cheese."—A communication from H. O. Freeman, Sherbourne, New York, U.S.A.—Petition recorded March 17, 1873.
1046. J. Baggs, High Holborn, Middlesex, "Improvements in the manufacture of gas for illuminating and other purposes."—Petition recorded March 20, 1873.

PATENTS SEALED.

2941. G. Robbe, Fenchurch Street, London, "A medical preparation applicable to the treatment of what is known as 'foot and mouth disease' in cattle."—A communication from J. M. Brunet, Dieppe, France.—Dated October 5, 1872.
2959. W. Lorberg, North Bow, Middlesex, "A new or improved process for the manufacture of soap."—Dated October 8, 1872.
2974. B. Tanner, Liverpool, "Improvements in the manufacture of artificial manures."—Dated October 9, 1872.
3080. H. Bethell, Victoria Street, Westminster, "Improvements in the treatment of beer in order to prevent and remove acidity."—Dated October 18, 1872.
3585. F. M. Lyte, Asnières, France, "Improved process of treating and purifying crude phosphoric acid, and in the production of soluble phosphates, also for the manufacture of phosphorus and the treatment of certain residues resulting therefrom and phosphate of alumina."—A communication from H. Storck, E. Heutsch, A. Heutsch, A. Lutscher, and F. Grininger, Asnières, near Paris, France.—Dated November 28, 1872.
3643. F. J. Bolton, Grosvenor Mansions, Westminster, "Improvements in compounds for coating leather in order to render it more endurable and less pervious to moisture."—Dated December 3, 1872.
3957. J. W. Spencer, Newcastle-on-Tyne, "Improvements in the production of iron."—Dated December 24, 1872.
274. R. H. Patterson, Hammersmith, Middlesex, "Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose."—Dated January 23, 1873.

NOTES AND QUERIES.

Logwood Extract.—This has now become very extensively used in this country, but I cannot hear of it being manufactured, only in France and America. Often have I made enquiries about it, but as yet without any success.—J. H. B.

Derivatives of Methyl Hydride.—Ladenburg has been working upon very varied derivatives of methyl hydride; he is probably correct in regarding them all as conforming to the type of marsh-gas, C_2H_3,H (old notation). Can any reader kindly inform why one of these is called—

"Ortho-silico-propionic ether" $= Si_2(C_4H_5O_2)_3,E$,

and another—

"Ortho-silico-propionic acid methyl ether" $= Si_2(C_2H_3O_2)_3\,E$.

Also, why some of these bodies are *one vol.* hydrides instead of two?—S. E. P.

Manufacture of Sulphuric Acid.—As the manufacture of sulphuric acid has lately been a prominent subject in your journal, may I ask your practical readers a question relating to the mode of decomposing the nitrate of soda. Is there not a larger consumption of nitrate when the nitre-pots are heated by the hot gases from the burning pyrites in a chamber adjacent to the kilns, than when the pots are otherwise heated in a close oven, and the nitrous vapours conveyed separately to the tower or chamber—other circumstances being equal? In other words, in the first case, is not the sulphurous acid so hot as to deoxidise a portion of the nitrous vapour so completely that the latter loses its power of combining with the oxygen of the air, and transferring this to sulphurous acid?—A SUBSCRIBER.

MEETINGS FOR THE WEEK.

MONDAY, 21st.—London Institution, 4.
—— Medical, 8.
TUESDAY, 22nd.—Royal Institution, 3. Mr. Dannreuther, "On the Music of the Drama."
—— Civil Engineers, 8.
—— Anthropological, 8.
WEDNESDAY, 23rd.—London Institution, 7.
—— Society of Arts, 8.
THURSDAY, 24th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Royal, 8½.
—— Royal Society Club, 6.
FRIDAY, 25th.—Royal Institution, 9. Prof. Flower, "On the Palæontological Evidence of Modification of Animal Forms."
—— Quekett Microscopical Club, 8.
SATURDAY, 26th.—Royal Institution, 3. Prof. Odling "On Ozone."

TO CORRESPONDENTS.

*** Vol. XXVI. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

J. B.—(1) Chloroform is the best softener. (2) Linseed oil and whiting.

J. Cox.—The solution of chloride of zinc should have the sp. gr. of 1·025.

J. McCulloch.—Your letter arrived too late for insertion this week.

THE CHEMICAL NEWS.

Vol. XXVII. No. 700.

NOTE ON THE

ESTIMATION OF PHOSPHORIC ACID AS URANIC PHOSPHATE.

By ARCHIBALD KITCHIN.

The estimation of phosphoric acid as uranic phosphate is a method I believe rarely made use of by chemists, but which yields (with certain precautions) results quite as accurate as those obtained by the magnesium process, and possesses some advantages over the latter. First, the estimation can be conducted in the presence of lime, &c. Secondly, the precipitate is almost insoluble in water containing ammonium acetate, experiment showing that in water alone it is soluble to the extent of 1 part in 50,000; in water containing acetic acid it is rather less soluble, viz., 1 part in 67,000; and in water containing ammonium acetate and free acetic acid, 1 part in 330,000. Thirdly, the great atomic weight of uranium adds to the accuracy of the process, the ignited precipitate containing less than 20 per cent of P_2O_5. By most chemists the atomic weight of uranium is accepted as 120, and consequently, if the composition of the ignited precipitate be $(U_2O_3)_2P_2O_5$, the percentage of P_2O_5 present will be 19·78, but Fresenius and others take the atomic weight as 118·8, and the percentage of P_2O_5 in the ignited precipitate as 19·91; I think the following experiments tend to show the former is nearer the truth:—

Pure sodium phosphate in powder, and free from adherent moisture, was used; this salt, when dried and ignited, gave a residue weighing in two experiments 36·99 and 37·09 per cent respectively, the theoretical amount of $Na_4P_2O_7$ being 37·15 per cent. By the magnesium process it yielded in three experiments 19·91, 19·92, and 19·88 per cent of P_2O_5 respectively, theory being 19·83. This same salt gave by the uranium process results as stated in the following table. It will be seen that, when we take 120 as the atomic weight of U, the mean of the results is nearer to the theoretical percentage of P_2O_5 present in the salt than if we take the atomic weight as 118·8.

	$Na_2HPO_4+12H_2O$. Taken.	$(U_2O_3)_2P_2O_5$. Found.	Per cent of P_2O_5. Found. U=188·8.	Found. U=120.	Theory.
A.	1·2132	1·2173	19·97	19·84	19·83
B.	0·4847	0·4894	20·10	19·97	19·83
C.	1·3440	1·3495	20·00	19·86	19·83
D.	1·6848	1·6920	20·00	19·86	19·83
E.	0·4975	0·4997	20·00	19·86	19·83
F.	0·5295	0·5390	20·26	20·13	19·83
G.	1·2082	1·2075	19·90	19·77	19·83
		Mean ..	20·03	19·90	

In all the above cases, to the solution of the sodium phosphate in water, ammonia was added, and acetic acid to slightly acid reaction; the liquid was then brought to the boiling-point, and the uranic solution, in some cases acetate, and in others nitrate, added in slight excess. It was found that, if too much free acid was present, the precipitate took a much longer time to settle, and the supernatant liquid was not always clear; but, when the acetic acid was added to very faint acid reaction, the precipitate soon settled down, leaving a supernatant liquor quite clear and bright. "Fresenius" recommends the addition of a few drops of chloroform after precipitation, to cause the precipitate to settle more readily; but I have precipitated a great number of times, both with and without the after-addition of chloroform, and I cannot say that I have found it make any difference. The chief things required I believe to be a sufficient amount of ammonium acetate, and not too much free acid present; if these precautions are adopted, the precipitate settles in a few minutes. The washing is best done first by decantation, boiling up after each fresh addition of water, and lastly on the filter. After drying, the precipitate is strongly ignited until the filter is consumed; then a little nitric acid added, evaporated to dryness, and finally gently ignited; the residue should be of quite a yellow colour. If in the final ignition too much heat be applied, the uranic phosphate is reduced to a considerable extent, and turns a greenish colour; a second evaporation with nitric acid is then necessary.

Whitehaven, April 19, 1873.

ON THE

SEPARATION OF CAUSTIC SODA INTO PORTIONS OF DIFFERENT STRENGTHS ON PASSING FROM THE FUSED TO THE SOLID CONDITION.

By NICHOLAS GLENDINNING and ALFRED J. M. EDGER, Newcastle-on-Tyne.

When caustic soda, containing water in excess of the quantity corresponding with that of its hydration, passes from the fused to the solid condition, it separates into portions of different strengths.

In the manufacture of this article, when the batch has been brought to the required strength and condition, it is usual to pack it by pouring it whilst in the hot fluid state into iron casks or drums, wherein it solidifies on cooling. The sample is taken generally on a silver dish, or clean iron plate, during the packing process, and may be relied upon as accurately representing the mass; but a sample taken from the drum (after cooling) may, according to circumstances, differ from that taken during the packing operation by several per cents. As ignorance of this separation has frequently caused disputes between manufacturers and buyers as to the strength of the article, it may therefore be of some interest and value to those connected with its manufacture and consumption to learn the disposition of the various strengths in the drum, and the part from which a sample representing the average strength may be obtained. A drum of caustic soda, containing 66·8 per cent soda (Na_2O) and about 6 per cent water in excess of the water of hydration—as shown by the sample taken during packing—was cut through its centre transversely to its longitudinal axis, and samples taken as follows:—A, from the outside not extending more than 1 inch towards the centre; B, from a part about 5 inches nearer the centre; and C, from the centre. The radius of the drum was 11 inches. The following are the results:—

A.	B.	C.
66·9 p.c. Na_2O,	69·7 p.c. Na_2O,	61·6 p. c. Na_2O.

The outside, or A sample invariably agrees closely with the packing sample.

Analysis showed that the differences in strength of the samples taken from the drum are mainly attributable to water, but also in some measure to chlorides and sulphates, these bodies occurring in largest quantities in the C or centre sample.

The differences in strength, due to separation, will be greatly influenced by circumstances, *e.g.*, the quantity of water present, the temperature at the time of packing, and the size of the drum; but it is probable that caustic soda of very low strength (when such low strength is due to water) may not have this disposition to separate, as the temperature at the time of packing would be comparatively

low, and the solidification much more uniform throughout the mass.

We deem this separation due to the superior affinity for water possessed by the partially fluid caustic soda over that on the point of solidification.

ON THE CONSTITUTION OF AMYGDALIN.

By SAMUEL E. PHILLIPS.

The nitrogenous character of this glucoside places it out of the category of ordinary glucosides, and the difficulty herein is further enhanced by the statement of M. Schiff that it does not contain any ammonia, and that it is not an amide of amygdalic acid.

It is only after much study to trace its genesis as a cyanogen body, without any success, that we are compelled to fall back upon its ammoniacal character.

From this point of view we now try an application of the generic principles enunciated in a paper "On the Identification of Organic Radicals" (Chemical News, vol. xxvii., p. 99).

It is numerically immaterial whether we regard amygdalin sugar as 2 atoms of glucose or as 1 atom of diglucose; chemically, however, we prefer the latter alternative.

The acid, both chemically and otherwise, well accords with the formula of formic acid + almond oil — 2HO = $C_{16}H_6O_4$.

$$(C_2HO_2)O + HO + (C_{14}H_5)O + HO - 2HO =$$
$$\left.\begin{matrix} C_{14}H_4 \\ C_2\ H_1O_2 \end{matrix}\right\} = (C_{16}H_5O_2)O + HO$$

This acid + sugar − 2HO = $C_{40}H_{26}O_{24}$ = amygdalic acid,

$$(C_{16}H_5O_2)O + HO + (C_{24}H_{21}O_{20})O + HO - 2HO =$$
$$\left.\begin{matrix} C_{40}H_{20}O_{20} \\ C_{16}H_5\ O_2 \end{matrix}\right\} (C_{56}H_{25}O_{22})O + HO$$

The barium salt, $(C_{40}H_{25}O_{22})O + BaO$.

M. Schiff has obtained two acetic derivatives of this acid. Tetraceto-amygdalic acid = 4 acetic acid + amygdalic acid − 8HO =

$$\left.\begin{matrix} C_{40}H_{21}O_{22} \\ C_4\ H_3\ O_2 \\ C_4\ H_3\ O_2 \\ C_4\ H_3\ O_2 \\ C_4\ H_3\ O_2 \end{matrix}\right\} = (C_{56}H_{33}O_{30})O + HO$$

In obedience to well-marked analogies, I consider this a kind of anhydride to the actual acid of M. Schiff, which requires 4 more atoms of HO, and which may be pentabasic; hence the magnesia salt with $2\frac{1}{2}$ atoms of diatomic magnesia!

$$\text{The acid, } (C_{56}H_{33}O_{30})O + 5HO$$
$$(C_{56}H_{33}O_{30})O + 5MgO$$

Heptacetoamygdalic acid = 7 acetic acid + amygdalic acid −

$$\left.\begin{matrix} 14HO = C_{40}H_{18}O_{22} \\ 7\text{ acid} = C_{28}H_{21}O_{14} \end{matrix}\right\} (C_{68}H_{39}O_{36})O + HO$$

This requires 2 more atoms of HO to agree with the notation of M. Schiff, and it should be observed that though I have strictly followed M. Schiff's formula for the production of amygdalic acid, yet his context otherwise regards it $C_{40}H_{28}O_{26}$ or $(C_{40}H_{25}O_{22})O + 3HO$.

That I have rightly estimated the hepta radical is well confirmed by the heptacetyl-amygdalide of M. Schiff, which is $(C_{68}H_{39}O_{36})H_2N$; that is, $(C_{40}H_{25}O_{22})$, with 7 atoms of acetic radical replacing 7 atoms of H!

We now come to the ultimate nitro-product, which is—

Amygdalic acid + ammonia − 2HO =
amygdalin, $(C_{40}H_{25}O_{22})H_2N$.

Amygdalic acid + aniline − 2HO =
amygdalin-anilid, $(C_{40}H_{25}O_{22})PhHN$.

Amygdalic acid + 2 aniline − 4HO =
amygdalin-anilid, $(C_{40}H_{23}O_{20})Ph_2H_3N_2$.

Both these anilids are as yet hypothetic, but their production is a matter of great certainty, and the apparent anomaly herein becomes highly instructive. That his anilid should apparently contain a radical of $(C_{40}H_{23}O_{20})$, instead of $(C_{40}H_{25}O_{22})$, has been a standing perplexity, which is now fully resolved.

I gather from his able and extensive researches on glucoammonias and anilids that an hitherto-unobserved generic reaction subsists, in virtue of which the gluco-radical loses 2HO for every additional condensation of aniline or ammonia in the complex atom, whence the formula becomes—

Acid + aniline − 2HO = say, $(C_{40}H_{25}O_{22})Ph\ H\ N$
Acid + 2 aniline − 4HO = say, $(C_{40}H_{23}O_{20})Ph_2H_3N_2$
Acid + 3 aniline − 6HO = say, $(C_{40}H_{21}O_{18})Ph_3H_5N_3$

It will be found on examination that similar transpositions of radical are a wide and familiar feature in general chemistry. It is that by which morphia − 2HO becomes apomorphia.

Mannite, $(C_{12}H_{13}O_{12})O + HO - 2HO =$
Mannitan, $(C_{12}H_{11}O_{10})O + HO$.

Glycerine, $(C_6H_7O_4)O + HO - 2HO =$
Glyceride, $(C_6H_5O_2)O + HO$.

Glucose, $(C_{12}H_{11}O_{10})O + HO - 2HO =$
Glucosan, $(C_{12}H_9O_8)O + HO$.

Diglucose, $(C_{24}H_{21}O_{20})O + HO - 6HO =$
Caramel, $(C_{24}H_{15}O_{14})O + HO$.

Salicine, $(C_{26}H_{17}O_{12})O + HO +$ aniline $- 8HO =$
$(C_{26}H_{11}O_6)PhHN$.

Phloridzin, $(C_{42}H_{23}O_{18})O + HO + 2$ aniline $- 4HO =$
$(C_{42}H_{21}O_{16})Ph_2H_3N_2$.

In addition to these general cases, we now cite a few illustrations of the special character now under consideration.

Æsculin, $(C_{30}H_{15}O_{16})O + HO +$ aniline $- 2HO =$
$(C_{30}H_{15}O_{16})PhHN$.

Æsculin, $(C_{30}H_{15}O_{16})O + HO + 2$ aniline $- 4HO =$
$(C_{30}H_{13}O_{14})Ph_2H_3N_2$.

Æsculin, $(C_{30}H_{15}O_{16})O + HO + 3$ aniline $- 6HO =$
$(C_{30}H_{11}O_{12})Ph_3H_5N_3$.

Æsculetine, $(C_{18}H_5O_6)O + HO +$ aniline $- 2HO =$
$(C_{18}H_5O_6)PhHn$.

Æsculetine, $(C_{18}H_5O_6)O + HO + 2$ aniline $- 4HO =$
$(C_{18}H_3O_4)Ph_2H_3N_2$.

Æsculetine, $(C_{18}H_5O_6)O + HO + 3$ aniline $- 6HO =$
$(C_{18}H_1O_2)Ph_3H_5N_3$.

Caramel, $(C_{24}H_{15}O_{14})O + HO + 3$ aniline $- 6HO =$
$(C_{24}H_{11}O_{10})Ph_3H_5N_3$.

Helicin, $(C_{26}H_{15}O_{12})O + HO +$ aniline $- 2HO =$
$(C_{26}H_{15}O_{12})PhHN$.

Helicin, $(C_{26}H_{15}O_{12})O + HO + 2$ aniline $- 4HO =$
$(C_{26}H_{13}O_{10})Ph_2H_3N_2$.

Tetraceto-helicin, $(C_{42}H_{23}O_{20})O + HO +$ aniline $- 2HO =$
$(C_{42}H_{23}O_{20})PhHN$.

Tetraceto-helicin, $(C_{42}H_{23}O_{20})O + HO + 2$ aniline $- 4HO =$
$(C_{42}H_{21}O_{18})Ph_2H_3N_2$.

Tetrabenzohelicin, $(C_{82}H_{31}O_{20})O + HO +$ aniline $- 2HO =$
$(C_{82}H_{31}O_{20})PhHN$.

Tetrabenzohelicin, $(C_{82}H_{31}O_{20})O + HO + 2$ aniline $- 4HO =$
$(C_{82}H_{29}O_{18})Ph_2H_3N_2$.

Tetraceto-esculin, $(C_{46}H_{23}O_{24})O + HO + 3$ aniline $- 6HO =$
$(C_{46}H_{19}O_{20})Ph_3H_5N_3$.

Helicoidin, $(C_{52}H_{33}O_{26})O + HO + 2$ aniline $- 4HO =$
$(C_{52}H_{31}O_{24})Ph_2H_3N_2$.

As to the saltic forms of these anilids—

The chloro-platinate of trianil-caramel =
$(C_{24}H_{11}O_{10})Ph_3H_6N_3Cl + PtCl_2$.

The chloro-platinate of trianil-esculin =
$(C_{30}H_{11}O_{12})Ph_3H_6N_3Cl + PtCl_2$.

The chloro-platinate of dianil-esculetine =
$(C_{18}H_3O_4)Ph_2H_4N_2Cl + PtCl_2$.

&c., &c.

We now revert to M. Schiff's amygdalin-anilid, which follows the law of the dianilids, but from the speciality of its formation it can only have 1 atom of the phenyl radical instead of 2.

It is amygdalin, $(C_{40}H_{25}O_{22})H_2N +$ aniline $- 2HO =$
$(C_{40}H_{23}O_{20})PhH_4N_2$.

It is rather curious and may be somewhat instructive to notice that the nitrogenous glucoside of the Indigofera plant INDICAN — the sugar radical* + the 2HO necessary for the regeneration of the sugar (of which 1 H is retained to replace the lost radical) = INDIGO = $C_{16}H_5O_2.N$. And if amygdalin were similarly broken up the residue would be $C_{16}H_7O_2.N$.

As by the genetic antecedents of the latter, it would clearly be $(C_{16}H_5O_2)H_2N$, it will not be difficult to determine whether the former be $(C_{16}H_3O_2)H_2N$ or otherwise constituted!

We have inserted the saltic forms of dianils and trianils, as a rebuke to the modern doctrine that diamines are diatomic, and saturate 2 atoms of acid, and triamines 3 atoms, &c., &c.

The subject is referred to (CHEMICAL NEWS, vol. xxi., p. 289), and further investigation has fully established the welcome fact that a simple unity of principle pervades all such condensations, whether in alcohols or ammoniums.

In every case 1 H or equivalent is eliminated for every compound atom ingested, and the volume, type, and general character remain comparatively unaffected. A seven-fold condensed alcohol or ammonium, in either case, has 6 atoms of H eliminated!

Referring to the rosaniline varieties of so-called triamines, it is expressly said, "They do not form tri-acid salts." Indeed the sulphates and chloro-platinates correspond exactly with those now given from M. Schiff.

To such as patiently look forward for new proofs of a pervading unity in all natural phenomena, the transition from the present to a future chemistry may be hailed with high satisfaction.

ON HETEROGENESIS.

By O. LOEW.

SOME time ago a work on spontaneous generation, by Dr. Bastian, made its appearance, and gave rise to much comment and criticism in scientific journals, as well as in the newspaper press. Recently, Mr. T. Burdon Sanderson published in *Nature* an account of his experiments made with the view to contradict Bastian's statements; but he had to acknowledge that, under the circumstances described by the latter, living bacterias were obtained. He boiled infusions of turnips with some cheese in a retort *for ten minutes*, and sealed the retort immediately. After a few days the contents of the retort were examined under the microscope, and living bacterias were recognised. To every reasoning mind it will be evident that those observations, called by Dr. Bastian "*De novo* production of living things," do not prove anything at all with regard to "heterogenesis."

Pouchet, Mallet, Wyman, and other exact observers, had, *long before Bastian*, published the same facts; but Pasteur, the great French *savant*, had demonstrated that living germs were always the cause of life in boiled solutions. I myself, six years ago, made many experiments in regard to this question. I heated infusions of hay, diluted solutions of glue, milk, &c., in sealed glass tubes, *up to* 150° *C. for one hour*, and exposed some of those tubes to the action of the sun-light; others, provided for the purpose with platinum wire, to the action of electric sparks; others, again, I kept in the dark. After three months I opened those tubes in the laboratory of the celebrated physiologist, Prof. Ludwig, in Leipzig, with great expectations. Nothing living was found, to my great disappointment. All these tubes, however, after being opened, soon developed bacterias.

After looking over all the facts found by Dr. Bastian, we must confess ourselves unable to form an idea of what "*Bastianism*" means, which word is made use of in *Nature*. We are now just as much in the dark about the question of the original formation of organisms as ever, for there existed certainly neither turnips nor cheese at the end of the Azoic period, or during the formation of the Potsdam sandstone.

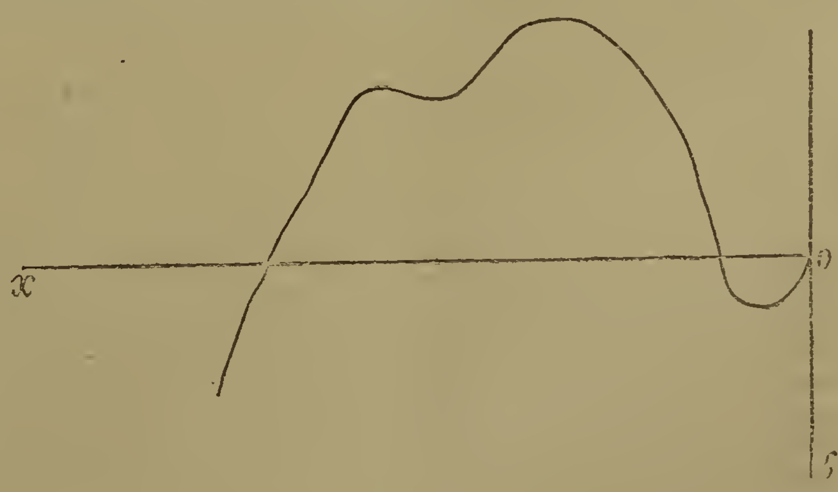
To any one who wants to gain information about all that has been done, and the experiments in regard to "heterogenesis," I recommend to study the very able article of Dr. H. Huppert, in "Schmidt's Jahrbücher für die gesammte Medicin," 1866. Bastian's work is simply the English translation of it.—*Engineering and Mining Journal.*

SOME RECENT RESEARCHES ON DIFFUSION OF GASES.

AT the last meeting of the Helvetic Academy of Sciences M. Dufour gave the principal results of an experimental inquiry into the variations of temperature which occur in diffusion of gases separated by a porous partition. He had studied, among other cases, those of hydrogen and air, of air and carbonic acid; and he distinguishes in these researches between diffusion at constant pressure and diffusion with varying pressure. A porous vessel containing the gas with slower diffusion (air or carbonic acid), and having a very sensitive thermometer applied to its inner surface, was placed in a larger and cloth-covered vessel, in which the other gas (hydrogen or air), was made to circulate. A glass tube through the stopper of the porous vessel communicated in some cases with the open air (constant pressure), and in others with a manometer. The thermometer was observed with a cathetometer.

It appears that with constant pressure (the glass tube communicating with open air) there is always elevation of temperature on the side of the entering diffusion, and lowering of temperature on the side where the diffusing gas issues from the partition. M. Dufour believes that this change of temperature is not produced throughout the whole gaseous mass, but only at the surface of the porous partition. He points out that at the side of entrance there is condensation, compression, and hence development of heat; while at the other, on the contrary, there is expansion of the gas, and so absorption of heat.

With varying pressure (the glass tube communicating with manometer) the phenomenon is more complicated. The indications of the thermometer are shown by the annexed curve, in which the abscissæ are the times, and the ordinates the temperatures.



M. Dufour also studied the diffusion between dry air and moist air. He found there was always a diffusion between two portions of air having different degrees of humidity; and, contrary to what might have been expected

* Indo-glucine = $C_{39}H_{30}O_{36}$ or $(C_{39}H_{29}O_{34})O + HO$
Diglucose = $C_{24}H_{22}O_{22}$ or $(C_{24}H_{21}O_{20})O + HO$

The expressions, "agreeing with, or strictly following the formulæ of M. Schiff," must of course be understood as quite independent of his atomic weights and constitutional formulæ. His amygdalic acid is—

$$\left.\begin{array}{l} C_6H_7.O \left\{ \begin{array}{l} (OH \\ O \end{array} \right. \\ C_6H_7.O \left\{ \begin{array}{l} (OH)_3 \\ O \end{array} \right. \\ C_7H_6.O \left\{ CO.OH \right. \end{array} \right\} = (C_{40}H_{23}O_{22})O + 3HO.$$

from Graham's law (aqueous vapour being lighter than air), this diffusion was found to be from the dry to the moist air. The law of variation of temperature in this case agreed with what was previously observed in the case of the two gases. It is contrary to what might be supposed from a manometer communicating with the porous vessel. The phenomenon of diffusion between two such portions of air can be easily demonstrated with the aid of a water-manometer. It is even so sensible that M. Dufour thinks the principle might be adopted in hygrometry. There must obviously be many applications of this principle in the organic world.

A new phenomenon of diffusion, which connects itself with some of those above referred to, has recently been studied by Herr Feddersen of Leipsic, who describes his experiments on the subject in *Poggendorff's Annalen*.

While M. Dufour inquired into the variations of temperature produced by diffusion on the sides of a porous partition separating two gases, Herr Feddersen has examined the effect of producing a difference of temperature at the two sides of a porous partition separating two portions of the same gas. His method of experiment was as follows:—A porous stopper was inserted in a glass tube. The tube was placed horizontally, and the two ends projecting beyond the stopper were connected, air tight, by means of caoutchouc with other glass tubes also placed horizontally, in each of which a drop of liquid formed a *movable* stopper. Thus every propulsive movement of the column of air in the middle glass tube would cause a movement of the drops in the same direction. One end of the fixed stopper was then subjected to a constant source of heat, while the other remained cold or was artificially cooled: whereupon a slow passage of the column of air through the stopper was uniformly observed, having the direction from the cold to the warm end of the stopper.

Spongy platinum was the first material used as stopper; a piece of 60 m.m. length being introduced into a tube 3½ m.m. in diameter. Quicksilver was at first used for the drops, but this was found too little sensitive to the air motion. Hydrated sulphuric acid was substituted, and, with a temperature-difference in the stopper of 10° (that of the room) and 100°, a slow motion of the drops was distinctly observed. For example, in an eight hours' observation the drop moved away from the heated end about 195 m.m. This motion was somewhat irregular.

In a second form of the experiment a shorter tube, 12½ m.m. diameter, had introduced into it a stopper of newly-annealed spongy platinum 31 m.m. in length. The two other glass tubes were 3½ m.m. diameter. One end of the stopper was raised to a temperature of 200°, while the other was at the temperature of the room, 8° (though latterly it became hotter through conduction). The following table gives the numerical results from this experiment:—

Time.	Cold Side. Observation.	Cold Side. Calculated for 10m. time.	Warm Side. Observation.	Warm Side. Calculated for 10m. time.
12h. 0m. to 12h. 10m.	225 m.m.	225 m.m.	tube removed	—
12 10 ,, 12 15	94	188	95 m.m.	190 m.m.
12 15 ,, 12 25	tube removed	—	241	241
12 25 ,, 12 30	105	210	95	190
12 30 ,, 12 35	110	220	tube removed	—
Side tubes removed, and after an hour and a half replaced.				
2 0 ,, 2 5	73	146	49	98
2 5 ,, 2 20	205	137	153	102
2 20 ,, 2 30	151	151	112	112
2 30 ,, 2 35	76	152	58	116

After the last observation the bent extremity of the glass tube on the cold side was put in sulphuric acid. The motion of the drops presently ceased, when the acid had risen about 6 m.m.; and this condition continued some hours, till the apparatus was taken asunder. Thus, allowance being made for capillary action, the difference of pressure produced on the two sides of the stopper through differences of temperature would correspond to a column of sulphuric acid at least 5 m.m. in height.

Spongy palladium was next experimented with, the gas employed being hydrogen. By a peculiar arrangement of T tubes the gas was introduced both into the stopper tube and into the connected tubes. The results here obtained were extremely irregular, owing, doubtless, in part to the variable absorption by the palladium with variation of temperature, and in part to aqueous vapour produced by contact of hydrogen with the atmospheric air; nevertheless there was always some motion in the expected direction. The following is one example in which the dimensions were as in the last case, and the drops used were of oil:—

Time.	Cold Side.	Warm Side.
9h. 5m. to 9h. 25m.	130 m.m.	—
9 25 ,, 9 35	155	190 m.m.
9 45 ,, 9 50	45	Mouth in contact with oil surface in cup raises small bubbles.

Gypsum.—In a tube 12½ m.m. wide was inserted a stopper 70 m.m. long of gypsum, which had become quite dry through exposure in air. The glass tube at one end of the stopper was covered with copper and heated to about 200° by a spirit-lamp placed below it; while the other end of the stopper remained at 8°. The motions of the sulphuric acid drops here employed were as follows:—

Time.	Cold Side. Observation.	Cold Side. Reckoned for 10m. time.	Warm Side. Observation.	Warm Side. Reckoned for 10m. time.
10h. 15m. to 10h. 45m.	{ tube removed }	—	60 m.m.	20·0 m.m.
10 45 ,, 11 30	,,	—	87	19·3
11 30 ,, 12 15	52 m.m.	11·5 mm.	45	10·0
12 15 ,, 1 15	52	8·7	32	5·3
1 30 ,, 2 0	20	6·7	23	7·7

Charcoal.—A stopper of charcoal 90 m.m. long was substituted for the gypsum. The sulphuric acid drop on the warm side did not at first move, while a quick motion of the other drop commenced at once. The table of numbers given by Herr Feddersen shows that the one drop was always more quickly moved than the other, whence it is inferred that, besides the phenomenon of the gas's movement in the tube, there was also a special absorption by the charcoal. A similar phenomenon had been observed with the platinum stopper, but the absorption was less in that case.

Silicic acid and *magnesia usta* were the remaining substances experimented with. In the case of the former, there was a slow motion of the drops, without indication of absorption of gas. A stopper of magnesia 40 m.m. long, in a tube 12½ m.m. diameter, gave the following results:—

Time.	Cold Side. Observation.	Cold Side. Reckoned for 10m. time.	Warm Side. Observation.	Warm Side. Reckoned for 10m. time.
7h. 30m. to 7h. 35m.	142 m.m.	284 m.m.	114 mm.	228 m.m
7 35 ,, 7 40	140	280	106	212

The numbers thus obtained for magnesia indicate an absorption of the gas.

From the foregoing experiments, it appears to be a common property of porous substances, when acting as a diaphragm in gas, to occasion a passage of gas from the cold to the warm side. This phenomenon of diffusion, unlike the ordinary diffusion, takes place when on both sides of the diaphragm there is the same gas with the same pressure. Herr Feddersen proposes to apply to it the name of *thermo-diffusion*.

He had not yet investigated whether this kind of diffusion was dependent on the nature of the gas, so that with mixed gases a selective diffusion might take place, *i.e.*, a mechanical separation of the gases similar to the separation produced in droppable fluids by diffusion. That such a phenomenon is not improbable appears, he thinks, from M. Dufour's experiments, and one fact observed by himself is favourable to the supposition. It is, that in the tubes a continuous decrease of motion was

perceived from the time of attachment; which must necessarily occur if, in the enclosed space on the cold side, one of the two constituents of the atmospheric air were more quickly diffused to the warm end than the other constituent; the enclosed space of that side must be sooner exhausted of the more readily diffusing gas than that of the other.

There is a reciprocity between Herr Feddersen's experiments and those of M. Dufour which is worthy of attention. And while the forces called into action in *thermo-diffusion* are probably very small, yet their influence in the economy of nature should not be overlooked.

A. B. M.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, April 17th, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous meeting having been read and confirmed, Messrs. Charles T. Kingzett, C. H. W. Biggs, Andrew F. Crosse, and T. Futcher Best were formally admitted Fellows of the Society. The donations were then announced, after which Messrs. William Henry Greenwood and Walter Hills were proposed for election. The names read for the third time were those of Messrs. James Hughes and Henry Tylston Hodgson, M.A., who were balloted for and duly elected.

The President then called on Dr. DEBUS to deliver his lecture "*On the Heat Produced by Chemical Action.*"

The speaker, in his preliminary remarks, observed that the ideas of the majority of chemical investigators at any given time appeared to flow, as it were, in one great stream; thus, at the present time, there could be no doubt that the attention of chemists was mainly devoted to organic compounds. Ten or twelve years ago the type theory was prevalent: as soon as any new compound was discovered the question was asked, To what type must it be referred? Previous to that, it was the theory of organic radicals, and so on.

Now it was very useful occasionally to turn away from this main stream of thought, as it were, to one of the minor side currents in which but comparatively few chemists were making investigations; such a subject was the heat developed by chemical action, which he had chosen for consideration on that evening. About twenty years ago or more, Favre and Silbermann had found that the heat developed by the oxidation of the metals was, generally speaking, closely related to their chemical affinity; for instance, copper precipitates metallic silver from its solutions, and zinc, in its turn, precipitates copper; and we say that the chemical affinity of copper is greater than that of silver, whilst that of zinc again is greater than that of copper, and it is also found that more heat is developed in the oxidation of zinc than of copper, and by the oxidation of copper than of silver. Professor Andrews, by a series of careful experiments, further proved that the heat developed by combustion stands in a certain proportion to the chemical affinity, but the clearest expression of these facts has been more recently given by Professor Thomsen, of Copenhagen.

Let us consider for a moment the effect of heating, say, a gramme of water. According to the mechanical theory of heat, the work done may be divided into three parts:—(1) External mechanical work producing expansion; (2) the raising of the temperature; (3) certain molecular changes; the two last expressing the internal work done. The first effect of heat on the gramme of water is to cause its expansion, and at the same time the temperature rises until it reaches 100°, the temperature then remaining constant until the whole of the water has been converted into steam, the heat added to the water during this period having become latent, that is, has been employed in overcoming the cohesion of the molecules, so as to convert the water into vapour. If we continue the heating, the temperature again rises, and the steam continues to expand until at 1400° or 1500° it possesses the properties of a perfect gas. At a higher temperature, the molecules of water begin to decompose into hydrogen and oxygen, which at 2000° amounts to about two-thirds of the whole, whilst at a still higher temperature, probably about 3000°, the water is entirely resolved into its constituent elements. On allowing this mixture to cool to 1500°, the elements re-unite, and at the same time give out the heat they had previously absorbed, which is thus a true measure of the affinity between oxygen and hydrogen; and as the aqueous vapour thus formed condenses again into water, a further amount of heat is liberated, due simply to physical changes, so that, on burning a mixture of oxygen and hydrogen, the heat evolved is not simply a measure of their affinity, but is complicated by that due to certain physical changes. In the case of the combination of hydrogen and chlorine, however, to form hydrochloric acid, the heat evolved is far more nearly a measure of the affinity of the two elements, but not quite, since hydrochloric acid is not a perfect gas.

In considering the relation of the heat of combination and chemical affinity, we may lay down three general principles:—First, by the direct combination of the elements heat is always developed. There is one apparent exception, that of carbon disulphide; but this is accounted for on allowing for the different physical state of the liquid disulphide of carbon from that of the solid sulphur and carbon which produce it, and inversely on decomposing the compound into its original elements the same amount of heat will be absorbed or become latent. This is clearly seen in the thermic results of the action of aqueous hydrochloric acid on cupric oxide—

$$CuO + 2HClaq = CuCl_2aq + H_2O.$$

The heat developed by the union of copper and oxygen is 43,770 units, and of 2H, 2Cl, and water to form aqueous hydrochloric acid $2 \times 39,315$; the sum for the left-hand side of the equation being 122,400 units, whilst on the right-hand side we have $Cu + Cl_2$ in presence of water, which develops 69,000 heat units and $H_2 + O$, $68,300 - 15,270$, due to the physical state of the water, making a total of 122,030 units, which is sensibly equal to that on the other side of the equation.

Again, the same amount of heat is developed in the formation of a compound, whether it be formed at once or by successive stages; thus, on burning carbon (charcoal) with sufficient oxygen to form carbonic oxide, 29,676 heat units are developed, and on burning the carbonic oxide thus formed to carbonic acid, 67,284 units more are developed, making a total of 96,960 units, which is precisely the same as that developed in burning charcoal directly to carbonic acid.

In certain cases, heat is rendered latent in the formation of compounds, but such combinations are never produced by direct union of their elements. Nitrous oxide, N_2O, is a substance of this class, and is always produced by the reduction of higher oxides of nitrogen. Graphite, when burnt to carbonic acid in nitrous oxide ($C + 2N_2O$), develops 134,000 heat units, and when burnt in oxygen ($C + O_2$) only 93,600, leaving a difference of 40,400 developed by the decomposition of the $2N_2O$; so that O, when it combines with N_2 to form N_2O, absorbs $\frac{1}{2}(40,400)$, or 20,200 heat units. A similar relation exists with potassium chlorate, and in a still more marked degree with potassium bromate, which, when gently heated with a very small amount of manganic peroxide, is decomposed with evolution of oxygen, and at the same time develops much heat; the action in the case of the bromate being almost explosive.

The lecturer, after showing that the so-called "Welter's law" is correct in comparatively few cases, proceeded to the consideration of the heat evolved by the oxidation of

the metals, which corresponds with the order of their affinity for zinc, iron, tin, lead, copper, mercury, and silver. In those elements which, like phosphorus, sulphur, and carbon, are susceptible of allotropic modifications, the heat of combustion is as their specific heats; thus charcoal, when burnt, evolves more heat than graphite. If we compare the heat evolved by the combination of any metal, say potassium, with chlorine, bromine, iodine, and sulphur, we shall invariably find that more heat is evolved in the formation of the chloride than in that of the bromide, and similarly, on comparing the bromide with the iodide, and the iodide with the sulphide; moreover, if the metals be arranged according to the amount of heat evolved in the formation of either the chloride, bromide, iodide, or sulphide, the order will always be the same, viz., that of their affinity. Further, supposing a metal, M, combines with chlorine and with bromine, forming the corresponding chloride and bromide, and that a second metal, M', also combines with chlorine and bromine, the thermic relation, expressed by the equation $MCl - MBr = M'Cl - M'Br$, is approximately true; for instance, zinc, in combining with chlorine, evolves 113,134 heat units, and with bromine 89,714, whilst lead similarly devolves 85,322 and 62,578 units. $ZnCl$ (113,134) – $ZnBr$ (89,714) = 23,420 heat units, and $PbCl$ (85,322) – $PbBr$ (62,578) = 22,744 heat units, numbers approximately the same.

After noticing the interesting results obtained by Professor Thomsen by the combination of hydrogen with the metalloids, the lecturer passed on to the heat evolved by the burning of organic compounds, noticing that isomeric bodies do not develop the same amount, as, for example, ethylene, C_2H_4, and paramylene, $C_{20}H_4O$, the former of which evolves 11,858 heat units, and the latter only 10,928. Moreover, it is not possible to calculate the amount of heat produced by the combustion of organic substances; thus, acetylene (C_2H_2) evolves 310,570 heat units when burnt, and two of hydrogen (H_2) evolve 68,357, the sum being 378,927. And we should expect that ethylene ($C_2H_4 = C_2H_2 + H_2$) would evolve this amount when burnt; but, in reality, we only obtain 334,800, being a difference of 44,122 units, which is, perhaps, expended in overcoming the affinity which unites the H_2 with the C_2H_2. By extending the numbers thus obtained to marsh-gas (CH_4) we may calculate the latent heat of carbon vapour in the following manner:—One molecule of solid carbon, on burning, will develop 93,600 heat units, and four of hydrogen 136,714, from which we must subtract $2 \times 44,122$, or 88,224 units, representing the heat absorbed in overcoming the affinity between the carbon and four of hydrogen contained in marsh-gas (CH_4), giving a total of 142,060 units; by experiment, however, we find that the combustion of marsh-gas develops 209,900 heat units. This difference of 67,840 units represents, therefore, the latent heat of carbon vapour.

In a series of homologous alcohols or acids, it would appear that the heat developed on combustion is less the higher we ascend in the series, that is to say, the more complicated the molecule becomes, which we may suppose to arise from the molecular work performed in packing the molecules more closely together, as it were.

The speaker finally made a few remarks on the thermic effects of solution, and of the combination of acids and bases, particularly drawing attention to the fact that, whenever a salt dissolves without producing a compound with the water in definite proportions, heat is absorbed; for example, on adding sufficient water to dry cupric sulphide or calcic chloride to form a crystalline salt, heat is developed, but, on dissolving the crystals so formed in water, heat is absorbed and the solution becomes colder, the molecular state of a solution differing from that of ordinary chemical combination. The fact that in double decomposition that compound is always formed which develops the greatest amount of heat is well exemplified by the action of hydriodic acid on argentic chloride, which, as is well known, yields argentic iodide and hydrochloric acid. Silver, in combining with chlorine, evolves 34,800 heat units, and hydrogen, combining with iodine in presence of water to form aqueous hydrochloric acid, develops 15,004, the sum being 49,804 units; on the other hand, silver, in combining with iodine, yields 18,651 units, and hydrogen and chlorine, in the presence of water forming aqueous hydrochloric acid, 40,192, the sum being 58,843 heat units. This amount of heat is greater than that developed in the former case, and therefore double decomposition takes place, with production of argentic iodide.

The thanks of the Society having been tendered to Dr. Debus for his interesting and instructive lecture, the President adjourned the meeting until Thursday, May 1st, when papers will be read "On Zirconia," by J. B. Hannay, and "On a New Class of Explosives," by Dr. H. Sprengel.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 1st, 1873.

R. Angus Smith, Ph.D., F.R.S., Vice-President, in the Chair.

Mr. J. S. Kipping and Mr. J. Sidebotham were appointed Auditors of the Treasurer's accounts.

"*Note on an Observation of a Small Black Spot on the Sun's Disc*," by Joseph Sidebotham, F.R.A.S.

As there is again some speculation as to the existence of an intra-mercurial planet, and every little fact bearing on the subject may be of value, I have referred to my diary, and find that on Monday, March 12th, 1849, our late member, Mr. G. C. Lowe, and I saw a small circular black spot cross a portion of the sun's disc. We were trying the mounting and adjustments of a 7-inch reflector we had been making, and used an ink-box between the eye-piece and the plane speculum. At first we thought this small black spot was upon the eye-piece, but soon found it was on the sun's disc, and we watched its progress across the disc for nearly half an hour. The only note in my diary is the fact of the spot being seen; no time is mentioned, but if I remember rightly it was about 4 o'clock in the afternoon.

Mr. Baxendell, on behalf of Mr. Sidebotham, F.R.A.S., exhibited a knife, the blade of which is steel, the bush at the handle brass, and the handle itself copper, all coated with nickel, beautifully polished. In a letter which Mr. Sidebotham had received from Professor Hamilton L. Smith, of Hobart College, Geneva, N.Y., the writer suggests the use of iron or bell-metal specula, coated with nickel, for reflecting telescopes. He says, "I ground and prepared a bell-metal speculum, which I coated with nickel, and this, when polished, proved to be more reflective (at least I thought so) than speculum metal. The two objects which I sought were—first, to have a polished surface unattackable by sulphuretted hydrogen (this, for example, is not injured by packing with lucifer matches); and, secondly, for large specula, doing most of the work by the turning-tool and lathe. I really think a large, say 3 feet, mirror, coated with nickel, but cast of iron, and finished mostly in the lathe, while it would not cost the tenth of a similar sized speculum metal, would be almost equal to silvered glass of the same size, and vastly more enduring as to polish.

Physical and Mathematical Section.

Annual Meeting, March 25th, 1873.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

The following gentlemen were elected officers of the Section for the ensuing year:—

President—Alfred Brothers, F.R.A.S.
Vice-Presidents—Joseph Baxendell, F.R.A.S.; Samuel Broughton.
Treasurer—Thomas Carrick.
Secretary—George Venables Vernon, F.R.A.S., F.M.S.

GLASGOW PHILOSOPHICAL SOCIETY.
(Chemical Section).

Ordinary Meeting, April 14th, 1873.

Mr. John Jex Long, Vice-President, in the Chair.

The President (Dr. Wallace, F.R.S.E.) read a paper on "*The Mortar of the Great Pyramid*," in which he gave a number of interesting details regarding the mortar employed in building the Great Pyramid; and incidentally referred to the composition of some mortars that he analysed a few years ago, including two from the exterior and interior of the Great Pyramid, two specimens of very ancient Phœnician mortar from the island of Cyprus, two from ruins at Athens, and from Rome and from other places in Italy. It was most interesting to observe the remarkable differences between the mortars of the various ancient peoples. By going to Baalbec and other ruined cities of Turkey in Asia, buildings might be found constructed of immense blocks of stone jointed with such excessive nicety that even the blade of a penknife could not be pushed between them, but without a vestige of mortar. In the structures of the ancient Egyptians, on the other hand, taking the Great Pyramid as an example, mortar was freely employed, but consisting almost entirely of gypsum or sulphate of lime. A specimen was examined from an ancient Phœnician temple, the highest stone of which was a few years ago 5 feet below the level of the ground at the time the specimen was taken. It was something like that found in some of the baronial castles in this country, and was like a piece of solid rock. The gentleman who brought it home supposed it to be the very oldest mortar in existence. If it were so, Dr. Wallace said that it was most remarkable, inasmuch as it was as perfect in constitution as it could possibly be, having been made evidently of burnt lime, fine sand, coarse sand, and gravel. It might be called concrete rather than mortar. At any rate, one thing was certain, namely, that the lime in it had become completely carbonated; and another specimen of the same age exhibited the same phenomenon, thus satisfactorily settling a point which was long in dispute. The ancient Greek mortars from ruins in the vicinity of Athens were also very perfect, but contained more lime than that from Cyprus, and no gravel. The mortars from various ruined buildings in Herculaneum, Rome, and its neighbourhood, appered to have been made from burnt lime and puzzuolana, or what is called by geologists volcanic ash. Dr. Wallace stated that he had had some correspondence with Professor Piazzi Smyth regarding the mortar of the Great Pyramid, some portions of which he read; and he gave the following analysis of a specimen which he had recently examined:—

Hydrated sulphate of lime..	92·83
Carbonate of lime	4·63
Carbonate of magnesia	1·66
Alumina and traces of oxide of iron ..	0·24
Silica	0·88
Water (hygroscopic)	0·07
	100·31

In reply to a question, Dr. Wallace stated that he believed the sulphate of lime, which is abundant near the Pyramids, had been partly calcined, to drive off the water of hydration in the mineral, before being used in making the mortar. There was very little cohesiveness in the samples exhibited.

"*Lake Deposits from India.*"—Dr. Wallace also gave a short account of several saliferous lake deposits from the East Indies, which had been sent to him for analysis with a view to advising as to their utilisation. The results of the examination were rather interesting. Lake deposits were known to occur in several countries—in Central Africa, in various parts of Asia, and in North and South America, where there are seasons of excessive drought, and where many salt-lakes have no outlet, not a few of them being far below the level of the sea. Examples were found in the Dead Sea, Lake Aral, and the Caspian Sea. The rivers flowing into such inland seas must necessarily carry various soluble salts, and these accumulate and ultimately crystallise out on the banks, or, if the lake becomes dry at any particular season of the year, they will form a crystalline deposit upon the surface of the bed of the lake. Dr. Wallace had no exact knowledge regarding the locality from which the salt deposits had been obtained, but he understood that they had been formed in the way just mentioned. The following are the analyses of four examples of the lake deposits:—

	Dulla Khar.	Nummuck Dulla.	Papree.	Bhooskee.
Soluble in water—				
Carbonate of soda (anhydrous) *.. ..	65·26	7·24	35·61	24·64
Carbonic acid in excess..	7·35	0·54	3·75	2·25
Carbonate of potash..	0·27	—	0·13	—
Chloride of sodium ..	0·60	86 66	39·21	20·17
Chloride of magnesium	0·67	traces	trace	trace
Sulphate of lime ..	traces	traces	trace	trace
Alumina and phosphate of lime.. ..	0·50	0·60	0·50	0·30
Insoluble—				
Carbonate of lime ..	1·80	1·13	3·95	2·20
Carbonate of magnesia				0·71
Oxide of iron				7·45
Alumina				5·35
Silica				14·45
Organic matter, chiefly insoluble	0·35	0·23	0·80	2·35
Water of crystallisation..	23·20	3·60	16·05	20·13
	100·00	100·00	100·00	100·00
* Equal to crystallised carbonate of soda..	17·60	19·50	96·10	66·50
Carbonate of soda ..	29·85	5·64	17·54	13·80
Sesquicarbonate ..	42·76	2·14	21·82	13·09

Dulla Khar.—Layers of hard crystals, mostly of a light brown colour, but some of greenish tint.

Nummuck Dulla.—An aggregation of large crystals of common salt of a rose-pink colour.

Papree.—Non-crystalline, and having more the appearance of a salt of lime than one of soda.

Bhooskee.—Of a light grey colour and earthy appearance.

The chief point of interest to chemists in the analysis of the deposit was the condition in which the soda existed. It was found that the text-books generally stated that the Trona of Egypt, and other saline deposits, consisted of sesquicarbonate of soda, but Dr. Wallace's analyses showed that the neutral and sesqui-carbonate were associated in very nearly equal quantities; and it appeared, likewise, that, under the circumstances in which the deposits were formed, a compound of soda was formed that contained very nearly 4 equivs. of soda to 5 equivs. of carbonic anhydride. In no case had Dr. Wallace found the soda and carbonic anhydride present in the proportions necessary to form either the neutral or the sesqui-carbonate. Some chemists who had examined somewhat similar deposits had given the soda entirely as sesquicarbonate, others had given it as neutral carbonate, but a few had given analyses corresponding with those of the author.

OBITUARY.

JUSTUS LIEBIG.

Justus Liebig was born in the small German town of Darmstadt, on May 13, 1803, and educated in Bonn and Erlangen. He was originally intended for a pharmaceutist, but having found the means of visiting Paris, and passing some time in the laboratories of the great French chemists who flourished in the year 1823, and, having achieved a success as a chemist, he was at once enrolled by Humboldt in the ranks of the German professoriat, being in 1826 nominated Professor in Ordinary in the University of Giessen, after having for the two preceding years held office as Extraordinary Professor in the same university.

Liebig began to publish very early. In the *Annales de Chimie et de Physique* for the year 1823, tome xxiv., p. 294, there is a paper entitled "Mémoire sur l'Argent et le Mercure Fulminans, par le Dr. Justus Liebig." About the same period there is also a note by Dr. Liebig, "Sur une Couleur Verte," which is an account of some observations on the making of arsenite of copper. It appears, however, that there were some publications of still earlier date, inasmuch as he refers to his own work in Buchner and Kasner's journal.

The first publication, however, which excited attention was the one on the fulminates, which was first mentioned: Analyses of fulminate of mercury and fulminate of silver, and the preparation of most of the other fulminates, together with their analyses. We can understand that Humboldt was struck with the young chemist's ability who had accomplished such a task.

In his professorship at Giessen, Liebig displayed the greatest activity, and gathered around him a knot of men whose names are household words among chemists. It was in Liebig's hands that ultimate organic analysis assumed the importance which it has acquired; and it was mainly owing to him that it was so popularised among chemists as to become one of the commonest resources of the laboratory. In *Poggendorff's Annalen* for the year 1831 may be read Liebig's own account of his improvements in the management of a combustion and in the apparatus. The following passage, which is exquisitely pithy and exquisitely modest, winds up the description:—"In this apparatus there is nothing new but its simplicity and thorough trustworthiness."* The paper is a study of chemical method, and might be read with advantage by chemists living in the year 1873. We must, says Liebig, separate the determination of nitrogen from the determination of carbon, and make two distinct and independent analyses. We must have a method which admits of operating on 3 or 4 grms. of substances which are poor in carbon, and on ½ to 1 grm. of substances which are rich in carbon. Liebig chose to weigh the carbonic acid instead of to measure it. In 1831 the measurement of gases was a matter of much greater difficulty than it is to-day, and the advantage gained at that period, by making the common combustion not to involve a gaseous measurement, was more striking than it is at present. Still, even to-day, there would be no gain in the substitution of measurements of carbonic acid for weighings of it, and the belief which some chemists entertain, that there would be, has its origin only in mental confusion and want of appreciation of the practical conditions under which analyses are accomplished and limited.

Much of that which is best established and most familiar to us in organic chemistry is the work of Liebig, and was accomplished long ago. The constitution of chemical history of benzoic acid was made out by Liebig and Wöhler. Hippuric acid was explored by Liebig. Aldehyde, which previously bore the name "light oxygen ether," and was known only in a very impure condition, was first rendered intelligible by him. Tyrosine, sarcosine, and creatinine, which are derived from flesh, are his discoveries. Though not the originator of the theory of compound radicals, he was one of its most powerful supporters, and contributed much of that which has proved to be most enduring in it. The theory of the existence of the radical ethyl is Liebig's, and the splendid investigation which led its authors to speak of the radical benzoyl was conjointly Liebig's and Wöhler's.

The application of chemistry to agriculture, and to many of the wants of daily life, received so powerful an impulse from Liebig, that the popular mind has taken him for the representative of the science in its application to practical purposes. So great, indeed, has his fame become as a technologist, that writers in English newspapers have overlooked the fact that he was one of the greatest chemists of the century.

Liebig left Giessen in the year 1852, and went to Munich, where he became Professor of Chemistry in the University and President of the Academy of Sciences. In 1845 he had been created a Baron. He died at Munich on the 18th of this month.

* "An diesem Apparate ist nichts neu als seine Einfachheit und die vollkommene Zuverlässigkeit, welche er gewährt.

DR. H. BENCE JONES.

We have to announce the death, on the 20th inst., after a long, and latterly, severe illness, of Dr. Bence Jones, the Secretary to the Royal Institution. Dr. Jones was a distinguished chemist; among his contributions to the advancement of science may be mentioned his Croonian Lectures "On Matter and Force," "Animal Chemistry in relation to Stomach and Renal Diseases," "Lectures on Pathology and Therapeutics," &c. His treatise on the early history of the Royal Institution, and his valuable biography of Faraday, are amongst the latest of his works.

In our issue of March 21st, we announced the fact of a movement being set on foot to get up a testimonial to Dr. Jones, which, in agreement with his own wishes, will take the form of a bust to be placed in the Royal Institution.

CORRESPONDENCE.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

Sir,—In reply to Dr. Lünge's observations on the above subject (Chemical News, vol. xxvii., p. 163), I beg to inform him, so far as his personal remarks are concerned, that Messrs. Allhusen's *is not* the only manufactory in which I have had experience in the manufacture of sulphuric acid, as I have had the advantage of being for a number of years engaged in many parts of both Great Britain and Ireland in the erection of such plant, and in some instances starting it to work; and that the acid plant with Glover towers, to which he refers as my knowing nothing about, was erected from plans prepared exclusively by myself, and the principal erections put up under my personal superintendence. I agree with him as to the ease with which chambers worked with Glover towers can be started by the use of an "extra quantity of nitre," but contend that those worked on that system require this "extra quantity" much longer than the others. This at first sight may appear trifling, but in reality is very serious, when from 10 to 12 per cent of nitre on the sulphur charged has to be used for days in place of from 3 to 4 per cent.

I still admire the rule-of-three where it can be applied with advantage, but in the case as shown by me it gives erroneous results, and therefore is no guide at all. The correct estimation of the nitrous compounds in the acid is a problem which has not yet been satisfactorily solved, and I, with your readers, will be happy to have the method

from which Dr. Lünge and his friends derive such great comfort in keeping their chambers in good working order.

I would also take this opportunity of pointing out a typographical error. In vol. xxvii., p. 137, twenty-seventh line from bottom, the figures 52·947 should be read as a whole number.—I am, &c.,

James McCulloch.

PURIFYING CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—The mode of purifying caustic soda described by Dr. Lünge to the Newcastle-upon-Tyne Society, and consisting in blowing air into the soda when in the dry fusion state, is by no means new. I invented and carrried out into working order the same process in 1865, since which time it has been in constant use at these works under my superintendence. I noticed, at the time Mr. Helbig's specification was published in this country, the most remarkable similarity to my method, even to the caoutchouc tube. I have used the term "my method" for convenience only, as in fact the method was patented in 1860 by W. Ralston, of Keele, Newcastle-under-Lyne, dated November 22, printed in "Repertory of Patent Inventions," June 1, 1861, page 496. This latter, and to me disagreeable, fact I only discovered when about to patent the invention myself. That the method has merits is, I think, being shown by the fact of a considerable portion of the trade adopting it.

Will you here allow me to correct an error which has crept into my previous letter, and which considerably alters the sense of the concluding paragraph. A single letter only has been left out. What I intended saying was that the bichromate method of estimating tin was in use in "this" (*i.e.*, Ardwick Bridge Chemical Works) laboratory, not "his," *i.e.*, Dr. Penny's laboratory, as I am made to say, in the early part of 1850.—I remain, &c.,

Peter Hart.

Ardwick Bridge Chemical Works, Manchester.

MISCELLANEOUS.

Appointment of Analyst for Sheffield.—At a meeting of the Sheffield Town Council held on the 9th inst., Mr. Alfred H. Allen, F.C.S., was elected Public Analyst for the borough by 39 votes to 13. The salary is £100 per annum. Mr. Allen is Lecturer on Chemistry at the Sheffield School of Medicine, and has given considerable attention to the detection of adulterations.

Royal Institution of Great Britain.—The following are the lectures to be delivered at this Institution, each lecture commencing at three o'clock:—E. Dannreuther, Esq. (three lectures), "On the Development of Modern Music in connection with the Drama, with Illustrations on the Pianoforte;" on Tuesdays, April 22, 29, and May 6. J. H. Parker, Esq., C.B. (four lectures), "On the Evidence for the Traditional History of Rome from Existing Architectural Remains;" on Tuesdays, May 13, 20, 27, and June 3. Professor Tyndall, LL.D., F.R.S. (six lectures), "On Light;" on Thursdays, April 24 to June 5. Professor Odling, M.A., F.R.S. (four lectures), "On Ozone;" on Saturdays, April 26 to May 17. John Morley, Esq. (three lectures), "On the Limits of the Historic Method;" on Saturdays, May 24, 31, and June 7. To the Friday Evening Meetings, Members and their friends only are admitted; the discourses will probably be as follows:—April 25th, Professor Flower, F.R.S., "On Palæontological Evidence of Gradual Modification of Animal Forms;" May 2, Professor J. Emerson Reynolds, M.D., "On New Alcohols from Flint and Quartz;" May 9, M. E. Grant Duff, Esq., M.P., "A Fortnight in Asia Minor;" May 16, Professor Sidney Colvin, M.A., "On the Limits of Certainty in Taste, or in Artistic Judgment;" May 23, W. Spottiswoode, Esq., M.A., LL.D., Treas. R.S. and R.I., "On Spectra of Polarised Light;" May 30, the Earl of Rosse, D.C.L., F.R.S., M.R.I., "On the Radiation of Heat from the Moon, the Law of its Absorption by our Atmosphere, and its Variation in Amount with her Phases;" June 6, Professor Odling, M.A., F.R.S.

Metropolitan Gas Supply.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of London and the Metropolitan Board of Works on the quality of the gas supplied by the Chartered, the Imperial, and the South Metropolitan Gas Companies during the last three months. Dr. Letheby states that the average illuminating power of the Chartered Company's gas at the several testing places has been as follows:—At Beckton, North Woolwich, 17·41 standard sperm candles; at Cannon Street, City, 17·22 candles; at Friendly Place, Mile End, 17·12 candles; and at Arundel Street, Haymarket, 16·78 candles. The gas of the Imperial Company has had an illuminating power of 17·30 candles at Carlisle Square, Chelsea; 16·07 candles at Camden Street, Camden Town; and 15·63 candles at Graham Road, Dalston. The average power of the South Metropolitan gas has been 15·79 candles; and the power of the cannel gas of the Chartered Company has been equal to 24·99 candles. As regards purity, Dr. Letheby reports that with one exception the gas at all the testing places has been constantly free from sulphuretted hydrogen, and that the average amount of sulphur in the gas of the several companies has been as follows:—11·76 grains per 100 cubic feet in the Beckton Gas, 9·42 grains in that at Friendly Place, 15·42 grains at Cannon Street, 18·02 grains at Arundel Street, and 16·12 grains at Millbank. The gas of the Imperial Company contained 32·11 grains per 100 cubic feet at Carlisle Square, 2946 grains at Camden Street, and 30·47 grains at Graham Road. The average amount of sulphur in the gas of the South Metropolitan Company was 36·11 grains per 100 cubic feet. With respect to this impurity, the referees have notified in their recent instructions for the gas examiners that the maximum amount of sulphur allowable in the gas of the several companies shall be 20 grains per 100 cubic feet of gas. This applies at the present time to the gas made at Beckton and Bow, and will apply to the gas made at other works after the 30th of June next. The amount of ammonia in the gas has not in any case exceeded 2 grains per 100 cubic feet of gas, and has averaged from 0·02 of a grain to 0·56.

Anthracene Blue.—A few years since aniline was the great source of new and beautiful colours. Now that every possible shade of colour, surpassing in number and beauty the hues of the rainbow, have been produced from aniline, the chemist has taken up the study of anthracene and alizarine, also coal-tar products. While preparing artificial alizarine from anthracene, Springmühl has obtained a by-product, from which he has made a beautiful blue colour, superior in some respects to any of the aniline blues. The process by which it was prepared he keeps a secret. Dried *in vacuo*, it is a blue powder with a few little crystals. In this it differs from the aniline dyes, which are one colour when dry, another when in solution. When pure hot water is poured over anthracene blue it mostly dissolves, but leaves a little insoluble residue. The addition of an alkali destroys its colour, which is restored, however, by an acid. The strongest mineral acids are unable to destroy its colour, but rather heightens its tone. Unlike aniline dyes, it is insoluble in alcohol and ether. Experiments show that it withstands the action of light better than aniline blue. Unfortunately, it is at present very expensive, for Springmühl obtained but 2·5 grains of anthracene blue from 25,000 grains of anthracene, which makes it cost about 3000 dols. per pound at present. A cheaper method of making it is certainly desirable.—*American Artizan.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 7th, 1873.

Becquerel on Electric Capillary Batteries and their Action.—The principle of electro capillary action consists in a property of the moist sides of capillary spaces; in virtue of which they conduct electricity like solid conducting bodies, whence result currents which produce in these spaces metallic reductions and other chemical actions. Such an electro-capillary element consists of an eprouvette containing a solution of nitrate or sulphate of copper, into which passes a slit-tube containing a solution of monosulphide of sodium. Into this enters another tube closed at its lower end with a spiral roll of paper, and containing a saturated solution of nitrate or sulphate of copper. Into the closed tube is introduced a slip of copper connected with a thin sheet of the same metal enveloping the outside of the slit tube. The latter is thus in communication with the deposit of copper formed in the crack by electro-capillary action. A battery formed of such elements is useful for producing slow, constant action. In the second part of this memoir the author shows the electro-capillary actions produced when a precipitate moistened with water, or with a solution, is in contact with a sheet of metal, more or less oxidisable, placed between two plates of glass, and cemented on the edges to prevent, as far as possible, the evaporation of water and the entrance of air. All the chemical effects produced are due to the joint action of affinities and of electro-capillary currents springing from the oxidation of the metal. In operating upon a zinc plate with chromate of lead moistened with distilled water, there were formed bibasic chromate of lead, more or less crystalline, and chromate of zinc. Using iron in place of zinc, the result was still bibasic chromate of lead in acicular crystals, ferric oxide, magnetic oxide in brilliant scales, mixed with chromate of iron and oxide of lead. Crystalline double oxalate of potash and copper was formed in an apparatus consisting of a tube closed at one end with parchment-paper, and containing a saturated solution of nitrate of copper, and of a beaker filled with a solution of potassic oxalate, into which the tube was plunged. The double oxalate was found in crystals on the exterior side of the paper, whilst the tube contained nitrate of potash. These researches lead the author to examine the opinions of physicists and chemists on the nature of affinities. He sums up his observations as follows:—In the molecular changes and chemical transformations of bodies we find produced calorific, electric, and sometimes luminous effects, which become the causes of affinities; but are the forces which produce them derived from the same principle and mutually convertible? If the same effect is produced in bodies, is the sum of the calorific or electric action constant? It is not proved. Heat and light are probably due to a vibratory movement communicated to the particles of bodies, but nothing gives a distinct indication that this is also the case with electricity and magnetism. When bodies are heated their volume changes, and reciprocally when their volume is changed thermic effects result. When there is no alteration in the state of aggregation the duty executed is equivalent to the heat emitted or absorbed. When molecular changes take place, they correspond to the amount of heat absorbed or emitted. In chemical actions we observe also thermic effects, but they only indicate the consequence of complex results, such as the mutual approximation or separation of molecules, especial groupings, &c. As to the disengagement of electricity in the changes of the state of aggregation of bodies nothing is ascertained. When bodies are unequally heated, if they are liquid no thermo-electric effect is observed. If solid, and if the parts in contact differ in nature, such effects become sensible. Still they are not energetic, and cannot serve to measure the effects produced. With metals those which have the highest specific heat are electro-positive. In the chemical action due to electricity, contrary to what is the case with heat, the laws are more simple, for each equivalent of electricity decomposes an equivalent of a compound body submitted to its action. The electro-capillary actions due to the joint influence of electricity, affinity, and molecular attraction introduce a new element into the question. If it is possible in certain cases to measure chemical action by the calorific effects produced, nothing similar can be done with the two electricities set free under the same circumstances, as they follow all conductors present, and even the extremely minute films of moisture adhering to non-conductors in order to re-constitute the "neutral fluid." These recompositions, after producing electro-capillary currents, take part in chemical reactions, and complicate the question of affinities. It may be remarked, further, that in chemical reactions produced with the aid of heat, such as fusion, nothing proves that there may not be electro-capillary currents acting as chemical forces—a question which will be treated in a future memoir.

Production of Ozone by Electric Action.—By M. A. Boillot.—A current of dry air gave a mean of 20 to 21 milligrms. of ozone to 5 litres of air, which corresponds approximately to 1 litre of oxygen. A current of oxygen in the same conditions gave 7 milligrms. per litre. In further experiments the precaution was taken to remove any nitrogen compounds by passing the air through a solution of caustic potash. The results were unaltered. Hence oxygen, in the condition in which it exists in the air, is more readily transformed into ozone in the proportion of 3 to 1 than pure oxygen gas. Another theoretical conclusion deducible from the above experiments is, that ozone cannot be a combination of oxygen with itself. The combination of several atoms of oxygen to form ozone seems to me to be a hypothesis no longer capable of being sustained.

Note on a Series of Artificial Gems Presented to the Academy.—Ch. Feil.—Fragments of pale rose-coloured matter fused by the aid of borax, and stated as composed of almost pure alumina, when illuminated by sunlight in the phosphoroscope, emitted a bright red light, the spectrum of which differed little from that of the light emitted by the ruby.

Note on the Effects Produced by Electric Currents on Mercury Submerged in Different Solutions.—Th. du Moncel.—A physical examination of the movements of mercury under the above circumstances.

Note on the Solvent Action of Glycerine on the Metallic and Calcareous Oleates, and on Sulphate of Lime.—E. Asselin.—Pure glycerine free from lime, of the sp. gr. 1·114, dissolved 0·71 per cent of iron soap, 0·94 of magnesia soap, and 1·18 of lime soap. The metallic and earthy sub-soaps, which impregnates the fibre of wool in the process of combing, are easily emulsified by water mixed with glycerine. Sulphate of lime dissolves in glycerine to the extent of 0·957 per cent, and the amount dissolved increases with the temperature.

Action of Chloride of Chloracetyl upon Aniline and Toluidine.—D. Tommassi.—Aniline and toluidine, under the influence of the chloride of chloracetyl, exchange an atom of hydrogen for an atom of chloracetyl, and give rise to two new crystalline products—phenyl-chloracetamide—

$$\left.\begin{matrix} C_6H_5 \\ H \\ C_2H_2ClO \end{matrix}\right\} N$$

and benzyl-chloracetamide—

$$\left.\begin{matrix} C_7H_7 \\ H \\ C_2H_2ClO \end{matrix}\right\} N$$

The former compound forms fine crystalline needles in an aqueous solution. It fuses at 97° C., and sublimes at high temperatures. Ether and acetic acid dissolve it in the cold to a large extent. Sulphuric and hydrochloric acid dissolve it easily when hot. Boiling nitric acid converts it into a new nitrogenous compound not yet analysed. Benzyl-chloracetamide crystallises in prismatic needles, which sublime at 110°, and fuse at 162°. It is insoluble in cold, and very sparingly soluble in boiling water. Sulphuric and acetic acids dissolve it sparingly in the cold, but freely when hot. In hydrochloric acid it is insoluble. By nitric acid it is converted into a nitro derivative.

Note on the Poisonous Effects of the Iodides of Tetramethyl-Ammonium or Tetramyl-Ammonium.—M. Rabuteau.—A physiological investigation. The iodides above mentioned destroy animal life by paralysing the nerves of motion; and their effects are, therefore, completely analogous to those of Curere or Wourali.

Revue Hebdomadaire de Chimie Scientifique et Industielle, February 13, 1873.

This number contains no paper of any chemical interest.

La Revue Scientifique de la France et de l'Etranger, April 12, 1873.

Professor Mascart contributes a long essay on theories in chemica instruction.

Annalen der Chemie und Pharmacie, No. 3, March 24, 1873.

This number contains the following original memoirs and papers:—

Studies on the Alkaloids contained in the Cinchona Barks. O. Hesse.—This exhaustive monograph contains a most complete historical, pharmacognostical, and chemical *resumé* of all that relates to this subject. The essay, though not suited for abstraction, is an excellent quinologicai *vade-mecum*, and a valuable contribution to the literature on the cinchona alkaloids.

On Aurine.—R. S. Dale and C. Schorlemmer.—After referring to the earliest discovery of aurine by Kolbe and Schmitt (1861), to the labours of these chemists, and also of Fresenius, the authors state that Fresenius's coralline and their aurine are not identical. They then proceed to detail first, the method of purification of the commercially made aurine, and next, quote the properties of this body in pure state. It is crystalline, soluble in alcohol, acetic and hydrochloric acids, fusion-point 220°; the aurine is also soluble in alkaline solutions which exhibit a brilliant fuchsia colour. Acids precipitate from these solutions a crystalline powder. Formula of pure aurine, $C_{21}H_{16}O_3$. The following combinations are further described:—Aurine-sulpho-dioxide, $2(C_{21}H_{16}O_3)SO_2+5\frac{1}{2}H_2O$; aurine-potassium-bisulphite,—

$$C_{21}H_{16}O_3+KHSO_3;$$

aurine-ammonium-bisulphite; leukaurine, the product of the action of iron and acetic acid upon aurine, $C_{21}H_{18}O_3$; triacetyl-leukaurine, $C_{21}H_{15}O_3(C_2H_3O)_3$; tribenzyl-leukaurine; coralline (Fresenius's). Aurine prepared from pure phenol differs from the aurine obtained

from that made commercially, and also differs from Fresenius's coralline. Pæonine is the product of the action of liquid ammonia upon aurine at from 140° to 150°.

Isuretin—a Basis Isomeric with Urea.—W. Lossen and P. Schifferdeoker.—Isuretin—$NH_3O+CNH=N_2CH_4O$—is the product of the action of hydrocyanic acid upon hydroxylamine. This exhaustive essay treats on—Preparation and properties of isuretin, which is a solid crystalline body, readily soluble in warm water, and more readily so in alcohol, fusion-point 104° to 105°, but partial decomposition sets in. Salts of isuretin, viz., hydrochlorate, sulphate, acid oxalate, neutral oxalate, picrate. Products of isuretin when decomposed by heat; action of dilute acids on isuretin; decomposition of isuretin by water; attempted conversion of isuret into urea; products of decomposition of isuretin are formic acid, ammonia, hydroxylamine, nitrogen, carbonic acid, urea, biuret, guanidin, and ammelid. Constitutional formula of isuretin—

$$C\begin{smallmatrix}\equiv N\\ \diagdown H\end{smallmatrix} + H.NH.OH = C\begin{smallmatrix}= NH\\ - NH.OH\\ \diagdown H\end{smallmatrix}$$

On Parabanic Acid Hydrate.—B. Tollens and R. Wagner.—This paper treats chiefly on the best method of preparation of the parabanic acid hydrate, viz., by the mild action of moderately strong nitric acid upon uric acid. The authors recommend the use of 3 parts of nitric acid (sp. gr. 1·3) to 1 of uric acid, care being taken that by the gradual mixing of these substances the temperature do not rise above 50°.

Monograph on Mellithic Acid.—A. Bayer.—This is the second instalment of a treatise, this section being mainly devoted to the polycarbon acids of benzols.

Phenanthren—a New Hydrocarbon from Coal-Tar.—R. Fittig and E. Ostermayer.—This paper, which has also been published in the *Ber. d. Deutsch. Chem. Gesells.*, is a more extensive essay on this subject.

Glyco-sulpho-urea.—J. Volhard.—The contents of this paper chiefly bear upon the fact that the author, previous to Maly's communication on this subject (*Anzeiger der K. Akad. d. W. zu Wien.*, No. 6, 1873), had already obtained this new compound, but with somewhat different results.

NOTES AND QUERIES.

Action of Heat on Gems.—Can any of your readers kindly describe the effect produced upon the sapphire and the emerald respectively when exposed to the oxyhydrogen flame?—X.

Perfect Vacuum.—Some years ago I remember seeing a description of an experiment by which it was shown that a really perfect vacuum would not conduct the electric current. I require to obtain a perfect vacuum for some experiments in which I am engaged, and I should feel greatly obliged if some of your obliging correspondents would give me a description of the mode of exhausting tubes to such a high degree. I believe Dr. Andrews was the one who described the method, and he employed potash and carbonic acid. The experiment was subsequently exhibited by Mr. Grove at a Friday evening lecture at the Royal Institution.—F.R.S.

Separation of Woollen from Cotton Fibre.—(Reply to "Subscriber.")—In the ordinary processes for recovering unmixed fibre, animal or vegetal, from rags of mixed tissues, one of the interwoven materials is sacrificed in order to obtain the other separately for use. Thus, if it be wished to recover the wool of mixed woollen and cotton rags, the mass is treated with a dilute solution of hydrochloric acid, which destroys the vegetal fibres of the tissue without sensibly affecting the wool. Many thousand tons of "shoddy" are made every year by tearing up in special machines, called "devies," the woollen threads thus recovered from mixed rags of wool and cotton stuffs, a class of rags technically termed in the rag trade "shallies." Rags of this class, when boiled in an alkaline, instead of an acid, solution, are disintegrated as to their woollen ingredient, while their cotton threads remain perfectly unaltered; and these latter are strained from the wool solution, washed in several waters to remove the last traces of animal matter, and then sold as raw material to the paper-maker, who further washes and bleaches them by the methods employed in bleaching ordinary coloured cotton rags. To avoid the necessity of thus sacrificing one material in order to serve the other, as also for the purpose of economising the consumption of costly chemicals in so doing, Mr. F. O. Ward some years ago devised a process by the use of which *both* classes of ingredients, the animal and the vegetal, are recovered in a saleable form, each product fetching in the market at least double the rate of price at which the raw material is obtainable. In this system, moreover, the only chemical agent used is water in the condition of steam. The effect of the steam upon the wool is to reduce it to a varnish-like coagulum—tough and tenacious while damp, but easily rendered brittle and friable by desiccation. The dried mass is beaten and tossed in rotating sieves, through which the woollen product falls as a fine powder rich in ammonia, and therefore very valuable as an agricultural fertiliser. Any fibres of *silk* and scraps of old *leather* as may be present in the mixed mass undergo the same transformation as the wool, and augment the weight and volume of the manurial product. The cotton threads, on the contrary, together with any flax, hemp, or other vegetable fibres that may chance to be present, are retained as fibre within the sieve, and sell as a paper material, of medium quality, ranking with the class of material known in the rag trade by the technical appellation "colours." Manufacturers desirous of practising this process should consult the chapter upon it in the "Chemical Jury Report of the International Exhibition of 1862," where a detailed description of the method is given; and fuller minutiæ could no doubt be furnished by the originator of the system, Mr. F. O. Ward, of London.—TECHNOLOGIST.

Experiments to Determine the Density of the Earth.—The following extracts from the paper on the above subject, by Henry Cavendish, Esq., F.R.S. and A.S., read before the Royal Society, June 21, 1798, and published in the *Philosophical Transactions* for 1798, will be read with interest, inasmuch as they show, not only the great care with which this important experiment was performed, but also point to some anomalies of disturbing force which have not even yet been satisfactorily explained:—

Pp. 469-470.—The leaden balls were 2 inches diameter, and were attracted by leaden weights 8 inches diameter. "The force with which the balls are attracted by these weights is excessively minute, not more than $\frac{1}{50,000,000}$ of their weight." "It is plain that a very minute disturbing force will be sufficient to destroy the success of the experiment; and, from the following experiments it will appear, that the disturbing force most difficult to guard against, is that arising from the variations of heat and cold; for, if one side of the case is warmer than the other, the air in contact with it will be rarefied, and in consequence, will ascend, while that on the other side will descend, and produce a current which will draw the arm sensibly aside."*

P. 484.—"These experiments are sufficient to show, that the attraction of the weights on the balls is very sensible, and are also sufficiently regular to determine the quantity of this attraction pretty nearly, as the extreme results do not differ from each other by more than $\frac{1}{10}$ part. But there is a circumstance in them, the reason of which does not readily appear, namely, that the effect of the attraction seems to increase, for half an hour, or an hour, after the motion of the weights. . . . . The first cause which occurred to me was that possibly there might be a want of elasticity, either in the suspending wire, or something it was fastened to."

P. 489.—"In the fourth experiment, the effect of the weights seemed to increase on standing, in all three motions of the weights, conformably to what was observed with the former wire; but, in the last experiment, the case was different; for though, on moving the weights from positive to negative, the effect seemed to increase on standing, yet, on moving them from negative to positive, it diminished." "My next trials were to see whether this effect was owing to magnetism. . . ."

P. 491.—" . . . . The effect produced could not be owing to magnetism."

"The next thing which suggested itself to me was, that possibly the effect might be owing to a difference of temperature between the weights and the case; for it is evident, that if the weights were much warmer than the case, they would warm that side which was next to them, and produce a current of air, which would make the balls approach nearer to the weights. Though I thought it not likely that there should be sufficient difference, between the heat of the weights and case, to have any sensible effect, and though it seemed improbable that, in all the foregoing experiments, the weights should happen to be warmer than the case, I resolved to examine into it, and for this purpose removed the apparatus used in the last experiments, and supported the weights by the copper rods, as before; and, having placed them in the midway position, I put a lamp under each, and placed a thermometer with its ball close to the outside of the case, near that part which one of the weights approached to in its positive position, and in such manner that I could distinguish the divisions by the telescope. Having done this, I shut the door, and some time after moved the weights to the positive position. At first, the arm was drawn aside only in its usual manner; but, in half an hour, the effect was so much increased, that the arm was drawn fourteen divisions aside, instead of about three, as it would otherwise have been, and the thermometer was raised near 1½°. On opening the door, the weights were found to be no more heated, than just to prevent their feeling cool to my fingers."

"As the effect of a difference of temperature appeared to be so great, I bored a small hole in one of the weights . . . . and inserted the ball of a small thermometer. . . . . Another small thermometer was placed with its ball close to the case. . . . ."

Experiments here follow, from which (expt. 6) the air therm. was 0·3° colder than the weight therm.; from expt. 7 the air therm. was 0·4° colder than the weight therm.; and from expt. 8 the air therm. was 0·5° colder than the weight therm.—(Pp. 493-495.)

P. 496.—"In these three experiments" (6, 7, and 8) "the effect of the weight appeared to increase from two to five tenths of a division, on standing an hour; and the thermometer showed, that the weights were three or five tenths of a degree warmer than the air close to the case. In the two last experiments, I put a lamp into the room, over night, in hopes of making the air warmer than the weights, but without effect, as the heat of the weights exceeded that of the air more in these two experiments than in the former."

Here follows a description of an experiment in which the weights were warmed by lamps. When 6° warmer than the air, "the arm was drawn aside about four divisions more, after the weights had remained an hour in that position, than it was at first."—(P. 496.)

In another experiment (p. 496), when the weights were "scarcely 2° warmer than the case," "the arm was drawn aside about two divisions

* "M. Cassini, in observing the variation compass placed by him in the Observatory (which was constructed so as to make very minute changes of position visible, and in which the needle was suspended by a silk thread), found that standing near the box, in order to observe, drew the needle sensibly aside; which I have no doubt was caused by this current of air."—P. 471.

more, after the weights had remained an hour in the position they were moved to, than it was at first."

(P. 496, 497).—"On May 23rd the experiment was tried in the same manner, except that the weights were cooled by laying ice on them; the ice being confined in its place by tin plates, which on moving the weights, fell to the ground, so as not to be in the way. On moving the weights to the negative position, they were found to be about 8° colder than the air, and their effect on the arm seemed now to diminish on standing, instead of increasing, as it did before; as the arm was drawn aside about 2½ divisions less, at the end of an hour after the motion of the weights, than it was at first."

"It seems sufficiently proved, therefore, that the effect in question is produced, as above explained, by the difference of temperature between the weights and case; for, in the 6th, 7th, and 8th experiments, in which the weights were not much warmer than the case, their effect increased but little on standing; whereas it increased much, when they were much warmer than the case, and decreased much, when they were much cooler."

"It must be observed, that in this apparatus, the box in which the balls play is pretty deep, and the balls hang near the bottom of it, which makes the effect of the current of air more sensible than it would otherwise be, and is a defect which I intend to rectify in some future experiments."—(P. 497.)

"Each of the weights weighs 2,439,000 grains."

"Each of the balls weighs 11,262 grains."

On p. 520 are given densities of earth calculated from 29 experiments. The mean of these is 5·48. The lowest is 4·88, and the highest 5·85.

P. 521.—"From this table it appears, that though the experiments agree pretty well together, yet the difference between them, both in the quantity of motion of the arm and in the time of vibration, is greater than can proceed merely from the error of observation. As to the difference in the motion of the arm, it may very well be accounted for, from the current of air produced by the difference of temperature; but, whether this can account for the difference in the time of vibration, is doubtful. If the current of air was regular, and of the same swiftness in all parts of the vibration of the ball, I think it could not; but as there will most likely be much irregularity in the current, it may very likely be sufficient to account for the difference."

P. 521.—". . . . It, indeed, may be objected, that as the result appears to be influenced by the current of air, or some other cause, the laws of which we are not well acquainted with, this cause may perhaps act always, or commonly, in the same direction, and thereby make a considerable error in the result. But yet, as the experiments were tried in various weathers, and with considerable variety in the difference of temperature of the weights and air, and with the arm resting at different distances from the sides of the case, it seems very unlikely that this cause should act so uniformly in the same way, as to make the error of the mean result nearly equal to the difference between this and the extreme; and, therefore, it seems very unlikely that the density of the earth should differ from 5·48 by so much as 1-14th of the whole."

P. 522.—"Another objection, perhaps, may be made to these experiments, namely, that it is uncertain whether, in these small distances, the force of gravity follows exactly the same law as in greater distances. There is no reason, however, to think that any irregularity of this kind takes place, until the bodies come within the action of what is called the attraction of cohesion, and which seems to extend only to very minute distances."

MEETINGS FOR THE WEEK.

Monday, 28th.—Geographical, 8.30.
—— Medical, 8.
—— Philosophical Club, 6. (Anniversary).
—— London Institution, 4.

Tuesday, 29th.—Royal Institution, 3. Mr. Dannreuther, "On the Music of the Drama."
—— Civil Engineers, 8.
—— Zoological, 1. (Anniversary)

Wednesday, 30th.—London Institution, 12. (Anniversary).
—— Society of Arts, 8.
—— Geological, 8.

Thursday, May 1st.—Royal Institution, 2. (Anniversary).
—— Royal, 8½.
—— Chemical, 8, J. B. Hannay, "On Zirconia." Dr. Sprengel, "On a new Class of Explosive."
—— Royal Society Club, 6.

Friday, 2nd.—Royal Institution, 9, Prof. Reynolds, "On Alcohols from Flints."
—— Geologists' Association, 8.

Saturday, 3rd.—Royal Institution, 3. Prof. Odling "On Ozone."

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THE CHEMICAL NEWS.

Vol. XXVII. No. 701.

MUTUAL DETERMINATION OF THE CONSTANT OF ATTRACTION, AND OF THE MEAN DENSITY OF THE EARTH.

By A. CORNU and J. BAILLE.

Since the discovery of the law of universal gravitation, it has been for astronomers and physicists an important problem to determine the numerical value of the constant expressing the reciprocal attraction of two units of masses placed at a unit of distance. The third law of Kepler would enable us to obtain directly the value of the total mass of two bodies reacting one upon the other, from a knowledge of two elements of their relative motions, the half-major axis of the orbit, and the period of a revolution if the value of this constant were known. The method of the deviation of a plummet proposed by Bouguer and La-Condamine only yielded, in the hands of Maskelyne, approximate results. The balance of torsion appears more accurate. The first experiments made with this instrument were planned by Mitchell and executed by Cavendish in 1798. The investigations were resumed by Reich, of Freyberg, in 1838; the principal improvement which he introduced consisting in the addition of a mirror for the measure of the deviations. The authors considered that the importance of the subject, to physics and mechanics as well as to astronomy, made further research desirable, especially as the experimental method employed is applicable, not merely to measuring the constant of attraction, but to a number of other physical determinations.

They commenced with a complete study of the torsion balance, especially as regards absolute measurements. The points especially studied are, besides the conditions of arrangement of the suspending wire, the lever, &c., the annulment of the most important causes of perturbation, and the law of the resistance of the air. The chief results have been the following:—The law of the atmospheric resistance is that in a space sufficiently extended the resistance is proportional to the speed, which permits the correction of the perturbations occasioned, and further, in a practical point of view the reduction, by a suitable form of the lever, of the coefficient of extinction of the oscillations due to this cause.

After these preliminaries the authors constructed apparatus to measure the constant of gravitation and the density of the earth, endeavouring to make arrangements differing as widely as possible from those of their predecessors, in order to vary the conditions of the experiment. The lever of the torsion-balance is a small tube of aluminium 50 centimetres in length, bearing at each extremity a ball of copper weighing 109 grms. A plane-mirror fixed in its middle renders it possible to observe with a lens a scale placed 5·60 metres off. The torsion wire is of silver, being 4·15 metres high. It has been fixed since September, 1871. The time of a double oscillation of the lever is 6 mins. 38 secs.

The attracting mass is formed by mercury contained in two hollow spheres of cast-iron. By aspiration the mercury can be passed from one of these spheres to the other, so as to double the effect of attraction.

The principal improvements as compared with the apparatus of Cavendish, Reich, and Bailey, are the reduction of the dimensions to one-fourth. It will be seen in examining the formula expressing deviation that this reduction is advantageous, for in apparatus geometrically similar (the time of the oscillation of the lever remaining the same) the deviation is independent of the weight of the suspended balls, and in the inverse ratio of the homologous dimensions.

The attracting mass has, therefore, been reduced to 12 kilos., in place of twice 158 kilos. as employed by Cavendish. The employment of mercury permits the displacement of the attracting mass without shock or vibration, which renders inversion very easy. Electric perturbations were eliminated by the metallic structure of all parts of the apparatus, and by their constant communication with the soil. Finally, the electric registration of the complete law of the oscillatory movement of the lever enables the observer to dispense with counting the time, and renders it possible to preserve in the form of graphic representations all the circumstances accompanying the observation. Two numerous series of observations were made in summer and in winter. The series of summer gave—

$$\Delta = 5{\cdot}56$$

That of winter—

$$\Delta = 5{\cdot}50.$$

The results confirm the number found by Cavendish. The authors conclude from these researches that the mean density of the earth is 5·56.

ON THE DECOMPOSITION OF METALLIC CARBONATES BY HEAT.

By L. JOULIN.

The substance, as dry as possible, is placed in a tube of glass 2 cubic metres in diameter, to the ends of which were fused at right angles two narrower tubes communicating, the one with a syphon-gauge, and the other with Alvergniat's mercurial pump; by means of which a vacuum can be formed, and the gas collected. A bulb filled with chloride of calcium had been arranged between the syphon-gauge and the decomposition-tube, in order to absorb the last traces of moisture which may exist in the substance. The space for gas to collect is 197 c.c. The part of the tube containing the substance is immersed in a bath of oil, the temperature of which is kept constant by means of a Friedel's regulator. The substance having been placed in the apparatus, a current of dry carbonic acid is passed over it for twelve hours. Then the gauge is filled, and the temperature of the oil-bath having been raised to 80° C., two exhaustions were made before observing the tensions, in order to eliminate all the gas that the pulverulent substance might have condensed.

Carbonate of manganese was produced by the reaction of equal equivalents of chloride of manganese. It was washed very many times by decantation, and dried at 66°, and cooled in an exsiccator under a bell-glass. 16 grms. of the precipitate were successively exposed for several hours to the temperatures 100°, 150°, 200; 100°, 100, 300°; each heating being preceded by a longer or shorter cooling. The results were that the carbonate of manganese was very perceptibly decomposed at 70° C. Up to 200° C. the decomposition presented the two characteristics of the phenomenon which Deville has named dissociation. That is, at a given temperature the tension of the carbonic acid reaches a value (215 m.m. at 150°), which remains constant within the limits of time of the operation, and that during the period of cooling the tension of the gas returns by degrees to its primitive value in consequence of the re-combination of the carbonic acid and protoxide of manganese. The limit of tension seems to decrease with the temperature. It is feebler at 200° than at 150°

From 250° to 300° the elastic force of the carbonic acid has increased constantly to 2 atmospheres. As the pressure-gauge did not go further, it was supposed that complete decomposition was commencing, a view confirmed by the fact that during the period of cooling the re-absorption was very slight. The substance, which remained white up to 200°, was turned brown at higher

temperatures, the protoxide of manganese having decomposed a little of the carbonic acid in order to convert itself into sesquioxide, as Debray found was the case with carbonic acid and the protoxide of iron. On analysis it was actually found that a part of the gas consisted of carbonic oxide. The substance successively heated to 100°, 150°, 200 was, after cooling, heated anew to 100°; and it was found that at this temperature the tension limit of the gas was less than the half of what it had been when the substance was heated to 100° for the first time (315 m.m.); in the third heating the limit remained the same (145 m.m.) as in the second. This phenomenon can only be explained by molecular changes which the carbonate of manganese had undergone in the successive heatings. Thus such pulverulent bodies would suffer a series of pseudo allotropic modifications.

Decomposition of Carbonate of Silver.—The decomposition of the oxide of silver was first studied. It was found that up to 250° the tension of the oxygen yielded by the oxide is very feeble, lower than 15 m.m. The decomposition of the carbonate can, therefore, be studied up to 200°. Complete decomposition takes place between 250° and 300°.

The study of the decomposition of the carbonate of silver has given results decidedly different from those yielded by the carbonate of manganese.

Lead.—Experiments made upon 13 grms. of cerussite (native carbonate of lead) have proved that the tension of the carbonic acid coming from its decomposition, very feeble (below 30 m.m.) at 150°, rises to 75 m.m. at 250°, and increases very rapidly at 300°, the temperature of complete decomposition, which at a pressure of 2 atmospheres was reached in two and a half hours.

All these experiments, which show the extreme instability of metallic carbonates, throw some doubt as to the analyses upon which H. Rose founded his theory of the hydrocarbonates. He has given no indication of the manner in which he dried his precipitates. The author concludes that at temperatures higher than 50° or 60° there is no security against the disengagement of carbonic acid.

ON THE CHARACTERISTIC PROPERTIES OF THE COMMON OILS.

By M. G. GLŒSSNER.

After having reviewed the characters of the various fatty non-drying oils (olive, almond, rape, sesame, palm), and of the drying (linseed, poppy, castor), the author tabulates the properties by which they may be recognised.

Action of Potassa in the Cold.—We agitate 5 volumes of the oil with 1 volume of potassa of sp. gr. 1·34. The mixture is:—

White—Almond, rape (best), bleached olive.
Yellowish—Poppy, olive, rape, sesame.
Greenish—Linseed, hemp. Oils containing copper, or artificially coloured.
Rose—Rape (refined).
Brown and compact—Hemp.
Yellow-brown and liquid—Linseed.
Red—Whale.

The oil is poured in a test-tube upon an equal measure of fuming nitric acid. There appears at the surface of separation a narrow transparent green zone—Almond.

Deep green, with a rosy halo at top—Poppy.
Clear blue-green—Olive.
Reddish brown—Linseed. After some time, the colouration extends to all the oil.
Green and red at the upper part—Rape.

Action of Concentrated Sulphuric Acid (10 drops of oil to 2 of acid).—Colour at the surface of separation:—

Fine green, with brown stripes—Rape.
Yellow, passing into olive-green when stirred—Poppy (*Media sativa*).
Red stripes, shading into black—Whale.

Equal volumes of acid and of oil dissolved in bisulphide of carbon:—

Fine violet colouration passing into brown—Whale.

Same proportions, without sulphide of carbon:—

Deep green colouration—Rape, linseed, hemp.
Red colouration—Whale.

Reaction of Elaidine.—The mass becomes solid, clotty, and white—Olive, almonds, rape (bleached). Ordinary rape oil gives a yellowish mass.

Red solid mass—Sesame.
Waxy white mass—Castor.
The mass of elaidine traversed by oily striæ—Mixture of drying oils.
No action—Linseed, poppy, nut.

Ebullition with Water and Litharge:—

Solid plaister—Olive.
Viscous plaister—Rape, almonds, sesame.
Viscous plaister, growing hard in course of time—Drying oils.

Solubility in Alcohol.

Olive	1 : 1
Poppy	1 : 25
Hemp	1 : 30
Linseed	1 : 40
Almonds	1 : 60

Specific Gravities.

Poppy, Rape	0·913
Almond (*Brassica campestris*)	0·914
Olive	0·918
Sesame	0·923
Sunflower	0·926
Castor	0·950—0·960
Linseed	0·930

Melting-points.

	Degrees.
Hemp	−27
Castor	−18
Linseed	−16 to −20
Sunflower	−16
Rape	−6
Brassica campestris	−4
Sesame	−5
Olive	2·5
Almond	−20 to −25

ON THE PROBABLE EXISTENCE OF MICROSCOPIC DIAMONDS, WITH ZIRCONS AND TOPAZ, IN THE SANDS OF HYDRAULIC WASHINGS IN CALIFORNIA.

By Prof. B. SILLIMAN.

The occurrence of diamonds of some size in the gold fields of California is by no means uncommon, and was noticed by me in a communication to the California Academy of Science in 1867, when specimens of this gem, from at least five different localities, were exhibited. I then suggested that a more attentive examination of the heavy sands left in the sluices of hydraulic washings would in all probability detect diamonds, mingled with other rare species not commonly believed to occur in these sands.

Mr. George A. Treadwell, of San Francisco, has lately sent me a small package of these sands, collected by him from the sluices of the "Spring Valley Gravel Mining Claim," Cherokee, Butte County, California. A microscopic examination shows these sands to abound in beautiful colourless zircons (hyacinths), of the form well known in the hyacinths of Expailly (France), associated with crystals of topaz, quartz in fragments, rounded

grains of chromic and titanic iron, and a few small, almost globular, masses of very high refracting power which appeared to be diamonds. To determine this chemically, a portion of the sands was treated with acid for the removal of any carbonates which might be present. There was no effervescence from this treatment. The same sample was then digested in strong sulphuric acid of a high temperature to destroy any particles of organic matter which might be present, washed out in pure water without contact with organic matter, dried, and ignited in a vessel of platinum out of contact with air. This sample of the sands thus freed from anything which could afford carbonic acid, but the diamond, was then ignited in a platinum nacelle (boat) in a tube of hard glass, and in a current of pure dry oxygen gas, which, for precaution, was passed over soda lime, and then, after passing the ignited assay, was delivered through a solution of baryta water. The transparency of this delicate test was soon disturbed, and by continuing the experiment for about an hour, a notable quantity of baryta carbonate was obtained. This experiment seems to prove that diamond powder was present in small quantity.

It will be remembered that Prof. Wöhler, some years since, found diamonds by a similar method in the platinum sands from Oregon, associated with the rare species *Laurite* —sulphide of osmium and ruthenium.

The black grains, which contribute fully one-half the bulk of the Butte County sands, are about equally chromic iron, which the magnet removes, and titanic iron, which is unaffected by the magnet. The chromic iron was so proved by the blowpipe, and no magnetite could be detected. No metallic grains of any of the platinum or iridosmium metals, or gold, could be found.

Under polarised light, these crystalline sands form a splendid microscopic object.

When I am provided with a larger quantity of these sands, I propose to determine the amount of diamond dust quantitatively.

In his letter to me, accompanying the sample sent, Mr. Treadwell says:—"I have examined much of the sand under the microscope, and think there are a few fragments of broken diamonds. These sands were taken from the tailings after passing through a long flume paved with stone. You know what sharp and hard pounding the gravel gets, mixed with boulders, in a hydraulic flume. No doubt some diamonds are ground, or rather broken, by hard knocks to powder."

A more attentive observation, by a mineralogical eye, of the sands accumulating in the sluices of hydraulic washings will, no doubt, be rewarded by the discovery of many rare species, which have thus far escaped notice for want of scientific skill. To show how much may be learned from an attentive study of such sands, Dr. John Torrey has informed me that in a sample of sands from gold washings in Nicaragua, he has found not less than twenty distinct mineral species, many of them of rare occurrence. No doubt a careful examination of the sands of Oregon, where Dr. Trask found the platinum minerals, would reveal many unsuspected species.

INVESTIGATIONS ON PARA-SULPHOBENZOIC ACID.

By IRA REMSEN.

A short time ago I commenced a series of investigations the object of which was to throw additional light upon the subject of "molecular re-arrangement in aromatic compounds." I was guided by the hope that many, if not all, of those cases of apparent anomaly, which had been referred to molecular re-arrangement, might by a careful re-examination find other and more satisfactory explanations; and that this inexplicable and dangerous bugbear might, in consequence, be forced at least from that division of organic chemistry which comprises the so-called aromatic compounds. Up to the present the object in view has hardly been approached, inasmuch as attractive byeways were soon disclosed, and these were followed. Leaving then for a future paper the consideration of the subject mentioned above until its study shall have become more complete, I shall here give a description of one of the byeways which drew me away from the main road.

I. *Para-Oxybenzoic Acid from Sulphobenzoic Acid.*

A most glaring case of apparent molecular re-arrangement is that noticed in connection with the formation of proto-catechuic acid from oxybenzoic and para-oxybenzoic acids; and the formation of pyrocatechin (and only this) by the dry distillation of protocatechuic acid. To this case I have already referred,* and it was, indeed, for a short time the subject of a discussion,† which ended temporarily in an unsatisfactory manner. I hope by its further study to be able to come to a definite conclusion in regard to it. My attention was at first directed to the study of the oxybenzoic acid from which the protocatechuic acid had been prepared. Adopting the method which had already been employed for the preparation of this acid, I converted a quantity of benzoic acid into sulphobenzoic acid, and melted the potassium salt of this latter with potassium hydroxide. On extracting the product in the usual manner by means of ether, and crystallising it from water, I was astonished to find that on cooling, well formed, slightly coloured crystals were deposited from the solution, instead of the crystalline mass or verrucous masses characteristic of oxybenzoic acid, which I anticipated. The general appearance of these crystals led immediately to the conclusion that in this case para-oxybenzoic acid had been formed, and further examination showed this to be true. The substance was re-crystallised from water, and then possessed all the characteristics of a pure chemical compound. The crystals were now colourless, and sharply defined in form; they were transparent, but, on being heated to 100° in an air-bath, they became opaque, the presence of water of crystallisation being thus indicated. The fusing-point was found to be 210° in repeated experiments, and decomposition took place when the crystals were heated slightly above the fusing-point; the point of solidification was 160°. All these properties taken together prove that the substance under consideration is not oxybenzoic acid, and the proof that it is para-oxybenzoic acid was rendered complete by the analysis, which gave the following results:—

I. 0·3308 grm. substance, heated to 110°, lost 0·0383 grm. H_2O.

II. 0·2925 grm. dried substance gave 0·6502 grm. CO_2 = 0·17733 grm. C, and 0·1181 grm. H_2O = 0·01312 grm. H.

	Calculated.		Found.
C_7	84	53·85	53·61
H_6	6	3·84	3·97
O_3	48	30·77	—
H_2O	18	11·54	11·58
	156	100·00	

Para-oxybenzoic acid, then, according to this, can be the product of the action of potassium hydroxide on sulphobenzoic acid. But this reaction has been employed for the preparation of pure oxybenzoic acid—first by Barth,‡ and afterward by Heintz,§—and, as neither of these chemists mention the formation of para-oxybenzoic acid under these circumstances, it is fair to suppose that, if formed, it escaped their attention; that it could not have made its appearance in such quantities as in the experiment described is evident. The question now naturally arose, whether the conditions under which I had prepared

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* *Zeitschrift fur Chemie*, N.F. 7, 294.

† See Barth, *Berliner Berichte*, iv. Jahrgang, S. 633; Ascher, *ibid*, iv. Jahrgang, S. 650; Fittig, *Zeitschrift fur Chemie*, N.F. 7, 181.

‡ *Ann. d. Chem. u. Pharm.*, cxlviii., p. 30.

§ *Ibid.*, cliii., p. 326.

the sulphobenzoic acid had been of influence on the product. Instead of waiting until the sulphuric anhydride had entirely dissolved the benzoic acid, as Barth did, I had added a small amount of fuming sulphuric acid to the semi-liquid mass after a time, and then heated gently until complete solution resulted. This shortened the operation somewhat, as the lumps of benzoic acid, which had become packed together, were thus brought under the direct influence of the fuming acid; whereas, before, they were covered with a thick pasty layer, which protected them.

In order to decide the question, I made two experiments. First, sulphobenzoic acid was prepared strictly according to the method of Barth, every letter of his directions being followed, and the acid thus prepared melted with potassium hydroxide. Second, sulphobenzoic acid was prepared by simply heating benzoic acid with fuming sulphuric acid, and the product melted with potassium hydroxide. Strange to say, these two experiments gave identical results, which differed from that already obtained. Para-oxybenzoic acid was indeed formed in both cases, but in much smaller quantity than in the first experiment. Instead of appearing in the first deposit of crystals, it was now not observed until the second or third, but then unmistakeably. It possessed all the characteristics of the acid—its crystalline form, fusing-point, water of crystallisation, &c.

After this, a large number of experiments were made with the object of discovering the conditions which are favourable to the production of para-oxybenzoic acid by means of this reaction; but, although this acid was in every case obtained as a secondary product in much smaller quantity than oxybenzoic acid, the greatest possible variations failed to bring about the first remarkable result. I was hence obliged to abandon the hope of clearing up this point, and to look upon the innumerable experiments as having increased, rather than decreased, the mystery. It is thus, at least, shown that the product, which had been looked upon as an individual substance, is in reality a mixture; and—inasmuch as the properties of oxybenzoic acid are such as to preclude the possibility of judging positively in regard to its purity from its appearance, and as its thorough separation from para-oxybenzoic acid by means of crystallisation, when the two are present in the mixture in anything like equal proportions, is an impossibility—I endeavoured to discover some other means which might be employed advantageously for the purpose of separation.

It seemed possible, from a study of the salts of the two acids, that the cadmium salt might be called in to aid successfully in this project; but experiment soon showed that, however well the cadmium salt of para-oxybenzoic acid might crystallise in a pure condition, it resisted all attempts when mixed with the oxybenzoate.

According to Barth, the basic barium salt of para-oxybenzoic acid is easily formed by the addition of an excess of barium hydroxide to a somewhat concentrated solution of the acid, and this salt, being insoluble, or nearly so, is precipitated under these circumstances, whereas no corresponding salt of oxybenzoic acid is formed. Taking advantage of this fact, the solution of the two acids was treated with barium hydroxide, and a precipitate was thus obtained. On decomposing this precipitate, a quantity of pure para-oxybenzoic acid was obtained; but, on examining that which still remained in solution, it was found to be a mixture, and this method of separation proved to be of no value. Since the publication of my first notice on this subject, Barth has repeated his former experiments, and confirms my statement that para-oxybenzoic acid is always formed in the preparation of oxybenzoic acid from crude potassium sulphobenzoate. He at the same time, however, remarks that pure oxybenzoic acid may be obtained by means of this reaction, it being merely necessary to re-crystallise the crude product a few times from water. It is very possible that a pure substance may be obtained in this way, but it is a difficult matter to prove positively that this is the case, especially as we know that there is a source of impurity which, as we have seen, may vary greatly in its influence upon the character of the product. It seems to me, then, that, whenever for test-experiments pure oxybenzoic acid is required, it would be advisable to become convinced of its purity by some other means, and I would suggest the preparation of pure acid barium sulphobenzoate as the first step. This salt can be readily obtained in beautiful perfectly-formed crystals, the appearance of which is a test of their purity, and from this *pure* oxybenzoic acid can be obtained.

II. *Para-sulphobenzoic Acid, a Constituent of Crude Sulphobenzoic Acid.*

The formation of para-oxybenzoic acid under the circumstances mentioned above, might be due to two causes—either meta-sulphobenzoic acid might yield it through the instrumentality of molecular re-arrangement under the influence of heat and fusing potassium hydroxide; or crude sulphobenzoic acid, prepared as above, might contain both the para- and meta-varieties, which would account for the complex character of the resulting oxy-acid.

To test the first possibility, a quantity of pure acid barium meta-sulphobenzoate was prepared, and then converted into the potassium salt. This was melted with potassium hydroxide, and the product carefully examined. Not a trace of para-oxybenzoic could be discovered in it. The experiment was repeated a number of times, but the result was invariable. The second possibility thus became more probable.

That portion of crude sulphobenzoic acid which had yielded the large proportion of para-oxybenzoic acid was now investigated, in order, if possible, to detect the presence of a second substance in it. It was neutralised with pure barium carbonate, and the excess of the latter and the precipitated sulphate then filtered off. The clear solution was separated into two equal portions, and from one of these the barium precipitated by pure sulphuric acid, care being taken to avoid the least excess of the latter. On now mixing the two clear solutions again, evaporating to the point of crystallisation, and allowing to cool, long, flat, acicular crystals made their appearance. These had no resemblance to the known acid barium salt of sulphobenzoic acid. They were re-crystallised from water, and were now obtained in exceedingly beautiful form; repeated re-crystallisations failed to change this form. This being established, the salt was analysed, with the following results:—

I. 0·525 grm. salt lost in weight constantly up to 200°; above this temperature no loss took place; the entire loss was 0·047 grm. This portion of the salt gave 0·206 grm. $BaSO_4$ = 0·12113 grm. Ba.

II. 0·5307 grm. salt lost 0·494 grm. at 200°, and gave 0·2078 grm. $BaSO_4$ = 0·12219 grm. Ba.

	Calculated.		Found.	
$(C_{14}H_{10}S_2O_{10})$ ..	402	67·79	—	—
Ba ..	137	23·10	23·07	23·02
$3HO_2$ ..	54	9·11	8·95	9·31
	593	100·00		

The formula thus deduced, viz., $(C_7H_5SO_5)_2Ba+3H_2O$, is, however, the same as that given for the known salt of sulphobenzoic acid; and hence, though the evidence might be strong in favour of considering the analysed crystals as representing a second and new variety of the salt, it was by no means conclusive. Two experiments were now made, the results of which were decisive. In the first place, the mother-liquor from the salt obtained was evaporated down, and then yielded a mixture of two well-characterised salts—the long flat crystals, and moderately well-formed, apparently monoclinic, prisms. On separating the latter as well as possible from the super-imposed crystals, and re-crystallising them, they were soon very much improved in appearance, being now perfect in form, and corresponding in every way to the known salt of sulphobenzoic acid. These, as well as the other crystals

mentioned, retained their form through a series of crystallisations. They were analysed for the purpose of comparison.

0·5182 grm. salt lost 0·0484 grm. at 200°, and gave 0·2038 grm. $BaSO_4$=0·1198 grm. Ba.

	Calculated.		Found.
($C_{14}H_{10}S_2O_{10}$) ..	402	67·79	—
Ba ..	137	23·10	23·12
$3H_2O$ ..	54	9·11	9·34
	593	100·00	

Again, the acicular crystals were converted into the potassium salt, and this melted with potassium hydroxide. The reaction was very clean, yielding immediately a perfectly colourless well-crystallised product. This possessed all the characteristics of para-oxybenzoic acid, viz.—the same degree of solubility in water, the same fusing-point, the same crystalline form; they also contained water of crystallisation. With these facts an analysis was deemed unnecessary. The conclusion is therefore justified that the acicular crystals are the salt of a second variety of sulphobenzoic acid, which, adopting the ordinary nomenclature, would naturally be called *para-sulphobenzoic acid.*

The presence of this acid in the crude product from the action of sulphuric acid in benzoic acid accounts, then, satisfactorily for the unexpected formation of para-oxybenzoic acid under the circumstances mentioned above. The varying proportions of oxybenzoic and para-oxybenzoic acids, as final products of the series of reactions, corresponded to similar varying proportions of meta-sulphobenzoic and para-sulphobenzoic acids formed in the primary reaction. This simultaneous formation of the two sulpho-acids is in perfect harmony with known facts, it being the rule that, when substitution-products are formed by the direct action of substituting agents upon the mother-substance, at least two varieties of the product are formed, if this is possible. But why is it that in one case a larger (sometimes very large) quantity of the para-acid is formed, while in another only a small quantity is formed? I have in vain endeavoured to answer this question; and it was with a feeling of great dissatisfaction that I was obliged to abandon it, as the solution of this problem would have had a much greater interest than the discovery of the para-sulphobenzoic acid. It appeared probable that the case under consideration might correspond to that studied by Kekulé* in connection with the isomeric varieties of sulphophenolic acid. In this case, the meta-acid is formed almost exclusively when the reaction is allowed to take place at the ordinary temperature, but, when the temperature is elevated, the amount of the para-acid is increased gradually, until finally it is the only product. The meta-acid is then converted into the para-acid by the action of heat and sulphuric acid. Acting according to the suggestion thus offered, I attempted to convert meta-sulphobenzoic acid into the para-variety; but, as already stated, no amount of heating, no matter how long continued, brought about the desired result. Variations in the method of preparation were introduced as long as thought continued to suggest them—some of these were apparently trivial, some decided; but I only succeeded in accumulating a mass of negative information of no particular value.

According to the experiments made, para-sulphobenzoic acid is always produced when sulphuric acid acts upon benzoic acid. When it is present in the product in comparatively large quantity, it can be readily separated from the isomeric compound by means of the acid barium salt. If, however, it is present in small quantity, as is generally the case, it is very difficult, if not impossible, to obtain it in a pure condition. On preparing the acid barium salt, and evaporating the solution of the mixture, pure meta-salt is at first deposited; but, when the solution has attained a certain degree of concentration, the two salts crystallise out together, the long crystals generally appearing first, and the monoclinic crystals of the meta-salt being then deposited upon and among these in such a complicated manner that the task of separating the two mechanically is not in the least attractive nor promising. Repeated crystallisations do not change the character of the crystals.

I now endeavoured to find other means of separation, and among those tested was the partial crystallisation of the acid sodium salts of the two acids. No better success attended this experiment. All other experiments made in this direction gave the same result. I was thus prevented from gaining possession of any respectable quantity of the new acid in this way, and, as its study seemed to offer a prospect of interesting results, I turned my attention to attempts to find other methods for its preparation.

(To be continued).

* *Berliner Berichte*, ii. jahrgang, s. 330.

ON A

RELATION SUBSISTING BETWEEN THE ATOMIC WEIGHTS, SPECIFIC GRAVITIES, AND HARDNESS OF THE METALLIC ELEMENTS.

By S. BOTTONE.

BY a careful consideration of the atomic theory, the writer was, in 1865, led to the conclusion that, if the ordinarily received notions respecting atomic heat, atoms, &c., were correct, a relation would undoubtedly exist between the relative specific gravity, atomic weight, and hardness of any given element. Many difficulties were encountered before any definite results were attained, owing principally to the difficulty of obtaining a definite scale of hardness, Mohr's scale being found to be utterly unreliable for this purpose, as a softer body was found to be able to scratch a harder one, provided a certain angle of the scratching surface were presented to the surface to be scratched. Other methods were therefore studied, in order to get an idea of the relative hardness of bodies; two of these will be described, the writer having found them to yield reliable and corresponding results.

1. A solid cylinder of highly tempered steel, of 1 centimetre in diameter, is fitted so as to run easily into a collar formed in the transverse bar of a rectangular metal frame. This steel cylinder, to which the name "plunger" has been applied, is so constructed at its upper extremity that measurable pressures can be at will applied, by means of a hydraulic press, or otherwise. The surface of the cylinder is graduated with millimetric divisions, so that the operator can read off easily the distance to which the cylinder, or "plunger," is made to descend. The bed of the frame is a thick plate of cast-iron. A small cake of the metal to be examined is placed on the iron bed directly under the plunger, this being raised to admit of its introduction. The operator now notes, by means of the scale on the plunger, the height at which it stands, and pressure is then applied until the plunger has descended, say, 1 centimetre. The pressure required to effect this is now noted,* and other cakes of different metals subjected to the same treatment, the pressures necessary to produce 1 centimetre of indentation being carefully noted in each case. These different pressures are in direct proportion to the hardness of the metal operated on.

2. This method, though perhaps not so exact as the preceding, is very useful in deciding the hardness of such metals as are brittle. It consists in mounting a soft iron disc on a lathe, and imparting to it a fixed invariable velocity. The metal to be tested is then applied to the edge of the disc, and pressed against it with a constant pressure. The *time* required to cut a certain depth will

* By means of a manometer.

be in proportion to the hardness of the metal examined, and this irrespective of its tenacity or brittleness.

Another point which rendered these experiments difficult was the almost absolute impossibility of obtaining some metals in a state of perfect purity, and the writer has noted with astonishment the extraordinary power which a mere trace of another metal has, in causing the hardness of a given metal to vary, sometimes increasing, and at others diminishing, this property to an unexpected extent. Great care has, however, been taken in the cases mentioned below; and, although other metals have been operated upon, the results are not given, as the metals were in a state of doubtful purity; hence the results might be misleading. Column 1 gives the sp. gr. of the metal (and this was actually verified in each case); column 2 gives the atomic weight; column 3 gives the relative hardness as deduced by calculation (by dividing the number denoting the sp. gr. by that denoting the atomic weight); and, lastly, column 4 gives the hardness as obtained by actual experiment, but reduced for facility of comparison to the same standard as column 3. It may not be out of place to remark that the temperature at which these experiments were made was 60° F.

Name of Body Examined.	Specific Gravity.	Atomic Weight.	Hardness* Calculated.	Hardness by Experiment.
Manganese ..	8·013	55·0	0·145690	0·145600
Cobalt	8·5	58·8	0·144559	0·145000
Nickel	8·279	58·8	0·140790	0·141000
Iron	7·7	56·0	0·137500	0·137500
Copper	8·66	63·4	0·136377	0·136000
Palladium ..	11·8	106·6	0·110694	0·120000
Platinum ..	21·5	197·4	0·108966	0·110655
Zinc	7·0	65·2	0·107692	0·107700
Indium	7·277	74·0	0·098337	0·098400
Gold	19·3	197·0	0·097969	0·097900
Silver	10·4	108·0	0·096296	0·099000
Aluminium ..	2·25	27·4	0·082116	0·082120
Cadmium ..	8·6	112·0	0·076785	0·076000
Magnesium ..	1·743	24·0	0·072625	0·072620
Tin	7·2	118·0	0·c61881	0·065090
Thallium ..	11·862	204·2	0·057405	0·056500
Lead	11·38	207·0	0·054975	0·057000
Sodium	0·934	23·3	0·040085	0·040000
Calcium ..	1·578	40·0	0·039450	0·040500
Potassium ..	0·865	39·15	0·022094	0·023000
Diamond ..	3·5	12·0	0·291666	0·300960

A glance at these figures will show the reader how nearly the theoretic result approaches to that of actual trial. The writer believes that, by a comparison of the hardness and specific gravity, we have another method, besides that of atomic heat, for checking the atomic weight of such metals as are doubtful in this respect. For this reason he prefers the figure 74, as denoting the atomic weight of indium, to that of 75·63, as it is more consonant with the hardness and specific gravity of this metal.

It is with much diffidence that the writer lays these results of his experiments before the reader, as he is aware that his appliances are very rough; but he trusts that they have yielded results sufficiently conclusive and interesting to merit further research in this direction.—*English Mechanic.*

THE PHYSOMETER, A NEW INSTRUMENT FOR THE DETERMINATION OF VARYING VOLUMES OF GAS AND OTHER SUBSTANCES.†

Few problems in nature have been more puzzling than the purpose served by the swimming-bladder in fish. Those who have sought to explain its action may be ranged according to two different standpoints—some have viewed it as an auxiliary organ of respiration; others as a hydrostatic apparatus, by which the fish can alter its specific gravity, and rise or sink in the water at will. The former view was first given expression to by Needham, in Amsterdam, in the year 1668, in a time when the limited state of anatomical and other science did not permit of its being fairly verified. The originator of the second view appears to have been a certain A. J., who contributed a paper to the Royal Society in 1675. In the following year appeared Borelli's work, "De Motu Animalium," in which it is stated that a fish whose swimming-bladder is damaged, so that the air has been allowed to escape from it, remains at the bottom; and the author infers that the swimming-bladder not only makes the fish specifically lighter, but that it effects the rising or sinking of the fish, according as it is expanded or compressed.

The purely mechanical explanation (confirmed, apparently, by the presence of muscles in the bladders of several fish) was soon afterwards generally accepted, and has found several advocates in more recent times.

In the beginning of the present century, a modification of this theory was rendered necessary by the researches of Biot, De la Roche, and others, who, having analysed the gases found in the bladders of fishes, found them to be the same as those in the atmosphere, but in different proportions; and, in the case of fishes taken from a considerable depth, it was found that the proportion of oxygen was very much greater than in the atmosphere (sometimes amounting to 90 per cent). This seemed to indicate that the oxygen in the bladder was separated out from the blood circulating in its walls.

More recently, in 1863, the important experiments made by M. Moreau have proved that the swimming-bladder is an organ in which the surplus of oxygen taken into the blood in breathing is for a time separated and stored up, afterwards to return into the blood when the fish finds itself in water containing too little oxygen. These researches gave a severe blow to the ultra-mechanical theory, and demonstrated that the swimming-bladder must be something more than a mere hydrostatic apparatus. Again, in 1866, two observers, Monoyer and Gouriet, came independently to the conclusion that the compression and expansion of the swimming-bladder were not to be regarded as the cause of the sinking and rising in water.

Much further investigation is still needed on the subject. The changes in the swimming-bladder, and the air in it, under different conditions during life, must be accurately determined. The most important of these conditions are—

1. The pressure to which the whole body, and so the swimming-bladder, is subjected, from the column of water above.

2. The quantity of oxygen dissolved in the water.

While the difference of pressure, which is dependent on the depth, must increase or diminish the volume of air without active expansion or contraction of the bladder, the volume can also be increased through a secretion of oxygen, and diminished through absorption of this gas, provided, that is, an equal volume of carbonic acid does not take the place of the oxygen (which is, on several accounts, improbable).

The question then is—Is there, in addition to these two chief causes of volume-change of air in the bladder, *a third?* Has the fish the power to compress this air or to remove existent pressure at will? For the present this must remain unanswered.

The presence, in some fishes, of muscular apparatus which might so act, does not compel the inference that such action occurs during life, nor that all other fishes have the same power.

It would be possible to give a satisfactory answer to the question only if we succeeded in making visible the volume-changes in the swimming-bladder during life. Any compression through muscular contraction should then reveal itself. The air, *e.g.*, contained in the swimming-bladder, will expand or contract quite gradually and regularly if the height of the superincumbent column changes. The volume-change, also, which is the result of

* Equal to sp. gr. divided by atomic weight.

† Abstract of a paper in *Poggendorff's Annalen*, by P. Harting.

a secretion or an absorption of air in the bladder, can only be gradual. Muscular contractions, on the other hand, generally take place quickly, at command of the will. If, then, the volume of the swimming-bladder is altered quickly, suddenly, especially if this change takes place in circumstances in which any alterations in external pressure are prevented, such a change may reasonably be attributed to muscular action.

In the year 1675, an experiment bearing on this subject was suggested by Robert Boyle, as follows:—

"To take a bolthead with a wide neck, and, having filled it almost full with water, to put into it some live fish of convenient size—that is, the biggest that can be got in, as a roach, perch, or the like,—and then to draw out the neck of the bolthead as slender as you can, and to fill that almost with water; whereupon the fish, lying at a certain depth in the water of the glass, if upon his sinking you perceive the water at the slender top does subside, you may infer he contracts himself, and if, upon his rising, the water be also raised, you may conclude he dilates itself."

I do not know whether this suggestion of Boyle's was ever carried out. It would obviously be difficult; and, if a fish were put in such an apparatus, the rise and fall of water in the slender neck would only show, what is doubted by no one, that the air in the bladder contracts when the column of water above the fish becomes longer, and expands when it becomes shorter. It appeared to me, however, that the idea forming the basis of this experiment might be usefully employed in construction of an apparatus which would permit not only of perceiving, but of measuring, the contraction and expansion of the swimming-bladder, and, moreover, of bringing the fish at will to a determinate point, higher or lower, in a column of water, the whole apparatus remaining closed and otherwise unaltered.

This apparatus, which I have termed the physometer, is of the following construction:—

A (Fig. 1) is a large glass cylinder, 63 c.m. high and 20 c.m. internal diameter, with a capacity of about 20 litres. It rests on a wooden disc, B, supported on three legs. A disc of thick plate-glass, *c*, covers the mouth of the cylinder (a little lard or wax having previously been put on the surfaces of junction), and is pressed down by an iron ring, *d*, having leather or caoutchouc under it, which ring is fixed in connection with the foot-piece by means of rods and binding-screws, *e e e*.

The glass disc has four openings, as seen in Fig. 2. One of these, *h*, in the centre, receives the thin measuring-tube, which indicates, by the rise and fall of water in it, the expansion or contraction of the contents of the cylinder. It has behind it a millimetre scale, supported on a square piece of lead which rests on the glass.

On either side of the middle opening, there is another, *i i*, having a brass guide fixed in it, in which the cylindrical brass rods, *m* or *n* (Fig. 1), can be moved up or down. These rods are exactly alike, about 64 c.m. long and 3·6 m.m. diameter. It is obvious that, if the one rod penetrates into the water exactly as much as the other comes out of it, the surface of the water-column in *o* remains unchanged. The extent of the rods' motion is indicated by scales, *s s*, similar to that in the centre. The rods are connected at their upper ends by a copper wire, which passes over the pulley, *u*, supported on the frame, *x v w y*. Thus, if one rod is pressed down a certain distance, the other rises just as much.

The fourth opening in the disc is in front of the central one, and serves for the introduction of water. It is closed by a caoutchouc stopper having two openings—one for a thermometer, the other for a short glass rod, which can be pushed up and down so as to bring the water-column in the measuring-tube, *o*, to a desired point, or to regulate its height.

To the lower extremity of either of the rods, *r r*, may be attached by a screw a sort of cage, C, of brass wire, and nearly as wide as the glass cylinder. This is for the fish, which is put in by a door on the upper side. The fish may either be allowed to swim freely in the cage, or be fixed to the sides. Other kinds of cage may be attached to the rods for experiments of a different kind.

It is important that there should be a perfect junction between glass disc and cylinder. The water employed should contain sufficient oxygen for a fish to be able to live in it some time. The apparatus should contain no free air.

When the instrument, containing cage, fish, &c., has been filled with water, and a measuring-tube has been

FIG. 1.

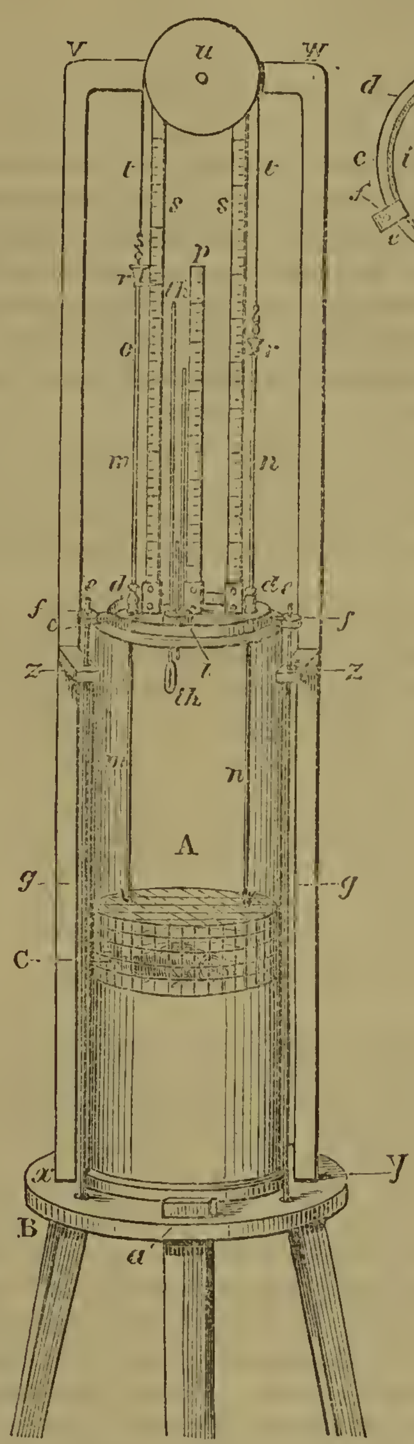
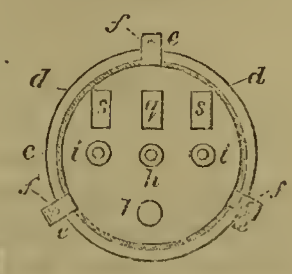


FIG. 2.



fixed in the centre of the disc, the caoutchouc stopper, with thermometer, but at first without glass rod, is put in the opening, *l*; any surplus water then flows out through the hole in the stopper. The glass rod being then introduced, the water-column in the measuring-tube can be raised to any desired height. The two movable rods, *m* and *n*, are connected by the wire, the scales are put in position, and the apparatus is ready for use.

A. B. M.

(To be continued).

CORRESPONDENCE.

LIEBIG'S EXTRACT OF MEAT.

To the Editor of the Chemical News.

SIR,—May I ask you kindly to mention that the lamented death of Baron Liebig will in no way affect the manufacture of the Liebig Company's extract of meat?

The control and analysis exercised hitherto by Baron Liebig and his delegate, Professor Max von Pettenkofer,

will in future be carried out, with the same knowledge, care, and attention, by Professor Max von Pettenkofer and Hermann von Liebig, son of Baron Liebig, he having acted so far as special assistant to his father in the control and analysis of Liebig Company's extract.

The well-known standard quality of the Liebig Company's extract of meat will thus continue absolutely unaltered.—I am, &c.,

CHAS. R. OTTER, Secretary.

Liebig's Extract of Meat Company, Limited, London, April 26, 1873.

NEW INSULATOR.

To the Editor of the Chemical News.

SIR,—Some time ago I discovered, in the course of experiments, that vegetable tar, by the addition of the oxides of lead (or in a less degree by some other substances), is almost instantly solidified, and that the solid substance thus obtained has remarkable insulating powers.

In some experiments at Silvertown, I found that No. 18 copper wire, covered with a coating of gutta-percha weighing only 21 lbs. to the mile, had its insulation increased nearly 200,000 per cent, and that the insulation resistance was no less than 2,800,000,000 units, an insulation sufficient for any lengths possible on the surface of the earth.

Insulation of so great cheapness makes all further experiments on telegraphy without insulation needless, though in fresh water or by land this can be effected to very great distances.—I am, &c.,

H. HIGHTON.

Putney, April 30.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—Two letters in your last issue call for a short reply on my part.

Mr. McCulloch's letter does not in the least invalidate what I contended, viz., that that gentleman stands quite isolated among Tyne-side practical men in his advocacy of "steam columns" against "Glover's towers" for denitrating the nitrous acid in the sulphuric acid process. He still does not say that he has had any practical experience in *working* with Glover's towers, and the fact that he has prepared the plans and partially superintended the erections for these towers in the last important Tyne-side factory which had hesitated to adopt them, does not prove very much against them. Your readers will judge for themselves whether Mr. McCulloch has made out any case against the exceptions taken by Mr. Glover and myself to his paper in your columns.

Mr. McCulloch further says that the rule of three gives erroneous results in the case referred to (the estimation of nitrous acid absorbed by sulphuric acid) and is therefore no guide at all. To this I must entirely demur; the practical acid-maker does not require an analytical method indicating the *absolute* quantity of nitrous acid, but it suffices for him to have a method allowing him to *compare* one sample of acid with another, in order to serve him as a safe guide in managing the chambers. In my laboratory the permanganate method is used, which takes only a few minutes for each test, and amply repays the small trouble.

It is hardly worth while disputing about the extra quantity of nitre required in starting a set of chambers, a contingency of such rare repetition; but I think Mr. McCulloch would have some difficulty to *prove* his assertion that a very serious (if any) extra quantity is required with Glover tower against steam columns.

Touching Mr. Peter Hart's letter, I have only to say that I have no connection whatever with Mr. Helbig's alleged improvement in the manufacture of caustic soda, except that of an abstractor of his paper published in *Dingler's Polytechnisches Journal*. Mr. Hart has, no doubt, proved that there is nothing whatever new in Helbig's process, and the only merit of the latter seems to be to have brought about this discussion, and elicited the testimony of such an experienced chemist as Mr. Hart in favour of what properly should be called "Ralston's process."—I am, &c.,

GEORGE LUNGE.

South Shields, April 26, 1873.

THE SODA PROCESS, AND PROPOSED IMPROVEMENTS.

To the Editor of the Chemical News.

SIR,—I have seen Mr. Hargreaves's letter of the 8th inst. (CHEMICAL NEWS, vol. xxvii., p. 183) to-day for the first time, and I regret that anything that I said in my paper should have appeared to disparage the process with which his name is connected. My paper was read last year, and I stated the prevalent notion then, that the process could not be worked to obtain a good sulphate without suffering a large quantity of sulphurous acid to escape. It is, however, gratifying to learn that Mr. Hargreaves has surmounted this difficulty, and, if his other statements, regarding fuel and repairs, stand the test of continued working on the large scale, the process cannot fail to be soon very generally adopted.—I am, &c.,

DAVID HILL.

St. Bede Chemical Works, South Shields, April 26, 1873.

MISCELLANEOUS.

Stalactitic Gelatinous Silica.—In experimenting at the Central High School with silicate of soda solution, it was found that when such solution is placed in a small porcelain capsule or other suitable vessel, and to it is added about an equal volume of concentrated sulphuric acid, taking care not to add to it too suddenly, the silica deposited prevents the thorough mixing of the acid and silicate. If now the vessel be inclined so as to allow the liquids to run as a stream from the vessel, the deposition of the silica takes place in the form of an icicle or stalactite depending from the lip of the capsule. On close examination, it is found that the acid runs upon the outside of the stalactite, whilst the silicate flows down the centre, or *vice versa*, the mass growing by successive additions to the lower extremity. The experiment is at once both pleasing and instructive.—*Elihu Thompson in the Journal of the Franklin Institute.*

Soluble Glass as a Detergent.—MM. Baerle and Co., of Worms, have published the following on the employment of soluble glass as a detergent:—The employment of soluble glass in the washing of wool is an important fact in this industry. The treatment is so simple and so economic that it is only necessary to make an experiment to recognise its advantages. Take 40 parts of water, at the temperature of 50° to 57° C., and 1 part of soluble glass; plunge the wool into the mixture, stirring it about for a few minutes by the hand, then rinse it in cold or tepid water, and it will be found completely white and void of smell. The wool after this operation remains perfectly soft, and loses none of its qualities, even when left for several days in the solution of the silicate, and being washed in hot water. Sheep may also be washed with the same preparation, care being taken to cover the eyes of the animals with a bandage, to perform the washing with the solution instantaneously, and to remove the surplus with tepid water. In the case of combed wool, the wool should be first steeped in the solution above given, and afterwards in another bath composed of 80 parts of water at 37° C., and 1 part of soluble glass. In this way the effect is excellent and economic, without the employment

of soap or soda, and the wool is rendered at least equally white, clean, and soft as by other methods. Soluble glass may also be employed advantageously for domestic washing. A bath must be prepared over night, with 20 to 30 parts of water at 50° to 57° C., and of 1 part of neutral soluble glass; the linen is plunged into this bath and left there till the following morning, when, after the bath has been re-heated with additional hot water, it is to be worked with a wooden stamper. The aspect of the solution tells when the linen is nearly cleaned, when the former is to be drawn off and the linen drained. The operation is then completed by rinsing with a little soap; but it is well to pass the linen again through a weak solution, consisting of 1 part of soluble glass to 50 parts of water at 45° to 50° C., and then to rinse it out in pure water.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 14th, 1873.

Theory of the Sun Spots.—P. Secchi.—This is a reply to M. Faye's last note correcting certain misrepresentations. In an appended note the writer states that, having examined the drawings of sun-spots and protuberances in 1871 and 1872, he finds that of 300 spot groups in the former year 209 were accompanied with eruptions (or two-thirds); of 292 in the latter 150 (or about a half): a proportion which he thinks significant for his theory.

Reply to P. Secchi and to M. Vicaire.—M. Faye.—The writer vindicates his former assertion that the eruption hypothesis involves a number of gratuitous assumptions.

Report on a Memoir of M. Boussinesq Entitled "Essay on the Theory of Water Currents."—The committee give a somewhat lengthy analysis of this important work; in which M. Boussinesq treats of the motion of water in pipes and in open channels—considering fluid sections of various forms, especially those which are rectangular and of considerable breadth, constant, or gradually variable, and the circular or semicircular. Also cases in which the bottom of the channel presents longitudinally a sensible curvature—non-permanent movements, such as those in rivers at times of flood—the laws which regulate the propagation of waves at the surface of flowing water, with the influence of slopes, friction, curves, &c. The committee remark on the agreement between the author's theoretical results and those of actual experience, and regard the treatise as one of much practical value.

New Observations on the Theory of Solar Cyclones.—M. Vicaire.

Note on the Effects Produced by Currents on Mercury Immersed in Different Solutions.—Th. du Moncel.—When the current from a battery of 8 Chutaux elements is passed through spring-water for an electrolyte—the electrode being a large drop of mercury connected with the negative pole, and a platinum wire with the positive—the polarisation current, on closing the secondary circuit after five minutes action of the battery, and through a circuit of 12 kilometres of telegraph wire, has at first an intensity represented by 7 or 8 degrees on a zinc galvanometer with two spirals of wire. This current gradually disappears in three minutes. With acidulated water the effects were less. With a saturated solution of chloride of sodium (other conditions the same) the polarisation current had at first an intensity of 25°, disappearing in fifteen minutes. With potash solution (salt in proportion of a fourth of weight of water) primary strength 26°; disappeared in fourteen minutes. With 3 per cent solution of cyanide of potassium, 18° 45'; twelve minutes. With solution of chlorhydrate of ammonia, 45° to 50°; five minutes. Thus we may form with these solutions gas couples and batteries of polarisation more energetic than those which have for base oxygen and hydrogen.

On Irradiation.—M. F. P. Le Roux.—The writer says he can at will neutralise irradiation. Thus, he can see the circumference of the luminous part of the moon continuous with that of the dark part; or see a flame no longer encroach on a screen placed beside it; the angles of white squares on a chess board no longer joined by a white ligament (indeed, the appearance may be reversed, and dark squares be seen joined by a dark ligament). He points out that for the field of distinct vision, about the *fovea centralis*, there is no irradiation. From this spot outwards the distinctness of perception rapidly decreases, and we naturally tend to equilibrate the sensations at the periphery of the object. If one of the horns of the lunar crescent is brought into the field of the *fovea centralis*, the irradiation there disappears; but by a peculiar compensation that at the other horn appears more than doubled. M. Le Roux further discusses the case of observation with the naked eye (as well as with telescopes when observing transits of Venus) of a dark ligament between two opaque bodies on an illuminated ground, and says that by sustained attention he can make these disappear. The ligament is not a phenomenon of irradiation, but of imperfect accommodation.

Mutual Determination of the Constant of Attraction, and of the Mean Density of the Earth.—A. Cornu and J. Baille.—(See page 211.)

Les Mondes, April 10, 1873.

New Variety of Hexylene.—M. Tchäikowsky.—Among the hexylenes of different origin one is known—that of Buff—which furnishes a primary hexylic chloride on combining with hydrochloric acid. Another—that of Erlenmeyer and Wanklyn—is converted into a secondary hexylic iodide on uniting it to hydriodic acid. It became interesting to attempt the preparation of an isomeric hexylene having the property of transforming itself into a tertiary hexylic iodide on the addition of hydriodic acid. Tchäikowsky has attained this object, setting out from methyl-diethyl-carbinol. This alcohol was obtained by the method of Boutlerow, by causing chloride of acetyl to react upon zinc-ethyl. The alcohol has been converted into the corresponding iodide by the action of gaseous hydriodic acid. On treating this iodide with an alcoholic solution of potash in sealed tubes, first in the cold and afterwards at 100°, he obtained a liquid hydrocarbon, colourless, lighter than water, having a strong odour, and boiling between 68° and 72°. On analysis it gave 85·06 carbon and 14·57 hydrogen. On combination with hydriodic acid this hydrocarbon yielded a tertiary iodide, that of methyl-diethyl-carbinol, and was convertible into the latter by treatment with moist oxide of silver.

On Ethyl-Trimethyl-Formene.—W. Goriainow.—This new hydrocarbon, an isomeric variety of hexane, has been obtained by the process which Lwow used for the preparation of tetramethyl-formene. Each drop of zinc-ethyl added to the tertiary iodide of butyl produces a strong reaction and rise of temperature. The fumes were passed first into hydrochloric acid, and then into alcohol well cooled. On adding water to the alcoholic solution and distilling, the hydrocarbon is collected as a colourless liquid. After treatment with bromine, and removal of the excess of the bromine by means of alcohol, the hydrocarbon is rectified, and treated for some time in the water-bath with metallic sodium. The greatest part of the purified hydrocarbon passes over at 43° to 48°. It contains 83·65 per cent of carbon, and 16·84 per cent of hydrogen. Its formula is assumed to be—

$$C_6H_{14}\left\{\begin{array}{l}C_2H_5\\(C\ H_3)_3\end{array}\right.$$

Formation of Tertiary Chloride of Butyl by Means of Isobutylen.—D. Salewsky.—Isobutylen was condensed in tubes containing concentrated hydrochloric acid, and well cooled. The tubes were then sealed and heated for some hours in the water-bath. On opening the tubes there was no escape of gas or vapour; all the isobutylen was combined, with formation of tertiary butylic chloride, almost pure.

Transformation of Amylene into Amylic Alcohol by Means of Sulphuric Acid.—M. Flavitzky.—A mixture of 2 parts of concentrated sulphuric acid, and 1 part of water was employed. The amylene was caused to act upon it in the state of vapour.

Action of Bromised Bromide of Acetyl on Zinc-Methyl.—D. Idanow.—The results obtained are indecisive.

Trimethyl-Acetic Acid, a New Isomer of Valeric Acid.—A. Boutlerow.—The acid is volatile without decomposition at 160·5° to 161·5°. The distillate is colourless, and solidifies immediately. The composition is $C_5H_{10}O_2$. It is insoluble in water. Its odour recalls that of acetic acid and valeric acid, but is less offensive than the latter.

Le Moniteur Scientifique Quesneville, April, 1873.

New Method of Oxidation, and New Explosive.—MM. Houzeau and Renard.—Hitherto chemists have only employed complicated reagents to disengage oxygen at higher or lower temperatures, such as mixtures of concentrated sulphuric acid with peroxide of manganese and bichromate of potassa, or bodies rich in oxygen like the chromic and nitric acid. These oxidising agents are open to the grave defect of determining either secondary reactions due more frequently to the influence of the acids or bases employed than to the oxygen liberated; or of producing too violent action which, raising the temperature, renders it impossible to trace the formation of the primary products. Houzeau has conceived the idea of employing concentrated ozone as an oxidising agent. He had previously shown the method of obtaining ozone in a concentrated state, by means of a simple tube supplied within and without with a metallic armature. As the decolourising power of ozone in relation to indigo is 40 times greater than that of chlorine, Houzeau was led to apply it to the formation of new organic compounds. One of the most remarkable results is ozobenzine, formed at ordinary temperatures by the action of concentrated ozone upon benzol. Ozo-benzine is a white, amorphous solid, which is immediately decomposed with violence when its temperature is sensibly raised. Its explosive force is so great that if a few decigrms. are submitted to a slight shock the windows of the room where the experiment is performed are shivered to fragments. Olefiant gas

detonates immediately with violence if brought in contact with concentrated ozone. If we take in connection with these facts the former observations of the same author on the presence of ozone in the air, and on the natural circumstances which seem to concentrate it occasionally in certain points of the atmosphere, we are entitled to ask whether, in some cases, conflagrations and explosions may not be due to this powerful chemical action, without any negligence or criminal intention on the part of persons concerned?

La Revue Scientifique de la France et de l'Etranger, April 19, 1873.

This number contains no original papers on chemistry or its allied sciences.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS

Delivered from October 5 to October 11, 1872.

A new or improved process for the manufacture of soap. William Lorberg, North Bow, Middlesex. October 8, 1872.—No. 2959. The features of novelty of this invention consist in a new or improved process of manufacturing soap. I take a definite quantity of fat, animal or vegetable, or a mixture of the two, or a mixture of either of the two and rosin in the state of thick oil in proportions varying according to the quality of soap it is intended to produce, the finer varieties of fat yielding a soap superior to that formed by lower descriptions of fatty matters. The fats to which I particularly refer are tallow, mutton suet, or a mixture of the two known in the trade as "melted stuff." Animal oils, such as fish oils, cocoa-nut oil, palm oil, palm-kernel oil, cotton-seed oil, olive oil, and the like. The said mixture is heated to the melting-point, say about 100° F., the object being to have the fats in a liquid state at as low a temperature as possible, merely to insure contact with the chemical ingredients, afterwards to be mixed with them. To this mixture I then add gradually and with diligent stirring from 50 to 60 per cent of a solution of caustic soda, indicating in the cold from 30° to 40° Baumé. As soon as combination has taken place, which it does with evolution of heat in a few minutes, I add water, solution of glutin, silicate of soda, or silicate of soda and potash, and for certain kinds of soap sulphate of soda, alumina, and carbonate of potash. The proportions of all these matters vary with the proposed quality of the soap, but in general they are as follows, namely, fat 100 parts, alkali 50 to 60 parts, silicate of soda or of soda and potash 25 to 50 parts, glutin 25 to 50 parts, water 20 to 50 parts. All the ingredients are added to the above compound in the cold, and thoroughly incorporated by stirring. The mass, which is now of a creamy subsistence, is covered up, allowed to heat and cool down again, which requires from twenty-four to forty-eight hours more or less, after which it is ready to be taken out of the frames and cut into slabs or bars, as may be desired. The soap then only requires to be seasoned, that is to say, to be exposed for some time to the influence of the atmosphere in a drying-room or other convenient shelter, which hardens and dries it.

Improvements in the manufacture of artificial manures. Benjamin Tanner, Liverpool, Lancaster. October 9, 1872.—No. 2974. This invention consists in the economical production of single, double, and triple superphosphates having one, two, or three alkaline bases instead of the lime, or in addition thereto, and the production of ammoniacal matters in combination or admixture therewith in a more or less rapidly soluble condition, so as to produce highly concentrated artificial manures. For the convenience of description the following paragraphs, which describe the processes embraced by this invention, are numbered consecutively:—

1. Solutions of any form of phosphate of lime and other mineral phosphates are made in hydrochloric acid, phosphoric acid, water, or mixtures thereof, by well-known arrangements. These solutions are treated with silicic acid, or sulphuric acid, or oxalic acid, or mixtures thereof, to remove any portion of the lime present, and, by preference, to reduce it in relation to the phosphoric acid to the proportion present in mono-calcic, bi-calcic, or tri-calcic phosphate. Sulphate, silicate, or oxalate of potash or mixture thereof, is or are then added to the liquor, for the purpose of removing all or a portion of the lime, and for substituting potash. The liquor is separated from any insoluble salts formed, and the clear liquor, on evaporation, yields a superphosphate of potash more or less intermixed with superphosphate of lime, and in such proportions as may be desired. Any other corresponding alkaline salt or salts may be used instead of, or in conjunction with, the potash added thereto, and any form of single, double, or triple superphosphate can thus be produced.

2. A very similar result is attained by adding the base or bases to be substituted for the lime or alkaline matter in a caustic condition, or in combination with any acid or elements which during the process of manufacture are decomposed or volatilised, such as chlorides, for example.

3. Phosphoric acid, or phosphoric and hydrochloric acids, more or less diluted with water, are also treated with the base or bases in a caustic condition, or in combination with any acids or elements (such as chlorides), which during the process are decomposed or volatilised, and their solutions, when evaporated, produce any form of single, double, or triple superphosphate. The superphosphates produced by the processes above described are sometimes further concentrated by dissolving the soluble portion in water, separating the insoluble matter, and evaporating the liquor as hereinafter described. If desired an additional quantity of alkaline matter is added.

4. These solutions, when prepared for evaporation, are intermixed with shoddy, woollen waste, blood, flesh, or other form or forms of nitrogenised matter, and evaporated to dryness, a single, double, or triple superphosphate being obtained, having ammoniacal matter in a slowly soluble form intermixed therewith.

5. The solutions described in paragraph No. 1 are also treated in the manner therein described, or solutions of phosphoric acid are intermixed with shoddy, woollen waste, blood, flesh, or other form or forms of nitrogenised matter, and evaporated to dryness. The product I call "ammonio-phosphate."

6. Phosphoric acid or solutions of phosphate of lime and other phosphates in hydrochloric acid, phosphoric acid, water, or mixtures thereof, is or are intermixed with ammonia, and with sulphate or bisulphate of lime. The proportions of the materials shall be, for every equivalent of phosphoric acid present there shall be present one, two, or three equivalents of lime, or any intermediate quantity; and for every equivalent of sulphuric acid there shall be one equivalent of ammonia present. The insoluble matter may be separated, and the clear liquor evaporated. The product will be a superphosphate of lime having ammonia in a rapidly soluble form intermixed therewith.

7. When it is desired to separate any portion of the ammoniacal salt formed as described in paragraph No. 6, the liquor which has been prepared for evaporation is concentrated sufficiently to enable the ammoniacal salt to crystallise out, the remaining liquor is evaporated to dryness, yielding a product similar to that described in paragraph No. 6, but less rich in ammonia.

8. The several forms of superphosphate herein described may be phosphated and rendered more powerful as a manure by the addition of phosphoric acid thereto.

9. It is preferred to carry out the evaporation by the use of steam, or hot air, or mixtures thereof, the action being safer and more satisfactory.

Improvements in the manufacture of alkalies, and in apparatus employed therein. James Hargreaves, chemist, and Thomas Robinson, ironfounder, Widnes, Lancaster. October 10, 1872.—No. 2982. Our said improvements consist, first, in intimately mixing sulphate of soda and sulphate of potash, or either of them, with coal or other carbonaceous material and metallic oxides, and fusing them in a crucible heated from the outside, the said crucible having an outlet at the bottom to allow the fused crude soda or potash to flow out when finished. Second, in using iron, preferably cast-iron, to form the crucibles aforesaid, or to form the beds and sides of furnaces used in the manufacture of crude soda or potash.

Improvements in evaporating liquids, and in the means or apparatus to be employed therein. Albert Ungerer, chemist, Simmering, near Vienna, Austria. October 10, 1872.—No. 2985. This invention, which relates to improvements in evaporating liquids, consists of a perpendicular shaft or tower constructed of stone or other suitable material, and covered with a perforated platform or cistern, from which a considerable number of wire or other ropes or rods are suspended into the interior of the tower. The liquid to be evaporated is first conducted to the top of the tower, and then allowed to run down through the perforations in the cover along the ropes or rods at a speed which can be regulated according to circumstances. Hot air or the products of combustion proceeding from a furnace enter the tower near its base, and escape through an opening near its top, meeting on their way the liquid spread over the immense surface afforded by the ropes, and thus concentrating the same by evaporation, more or less according to the heat of the gases and the speed at which the liquid is allowed to run down the ropes. It is preferred to place a cistern at the base of the tower, in order to collect the concentrated liquid and so that it may be removed.

NOTES AND QUERIES.

Action of Heat on Gems.—The effect of the oxy-hydrogen flame upon beryls and emeralds has been fully studied by Mr. Greville Williams, whose results will be published very shortly.

Oxychloride of Lead.—Can any of your readers inform me if it is possible to make oxychloride of lead perfectly white, and how?—C.

Removing Smell from Dissolved Gutta-Percha.—Would any of your readers kindly inform me of a method of removing the disagreeable smell left in gutta-percha and other substances when bisulphide of carbon has been used as a solvent? Long exposure of the substance, even in thin films, to the air does not answer the purpose. —M.

MEETINGS FOR THE WEEK.

Monday, 5th.—Royal Institution, 2. (General Monthly Meetings).
—— Medical, 8.
—— London Institution, 4.
Tuesday, 6th.—Royal Institution, 3. Mr. Dannreuther, "On the Music of the Drama."
—— Civil Engineers, 8.
—— Anthropological, 8.
—— Zoological, 8.30.
Wednesday, 7th.—Society of Arts, 8.
—— Microscopical, 8.
Thursday, 8th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Royal, 8.30.
—— Royal Society Club, 6.
Friday, 9th.—Royal Institution, 9. Mr. Grant Duff, M.P., "A Fortnight in Asia Minor."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
Saturday, 10th.—Royal Institution, 3. Prof. Odling "On Ozone."

SUPPLEMENT
TO
THE CHEMICAL NEWS.
Vol. XXVII. No. 701.

ON THE ALKALINITY OR ACIDITY OF CERTAIN SALTS AND MINERALS, AS INDICATED BY THEIR REACTION WITH TEST-PAPER.*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

A knowledge of the reaction of various substances with test-paper is justly esteemed of considerable importance, since it enables us at once to refer them to one or other of three distinctive groups, each of which has strict regard to the molecular structure of those substances falling within it, as manifested by the chemical combinations they are most prone to form. These groups are, as is well known, the alkaline or basic, the acidic, and the neutral, and properly prepared test-paper indicates the one to which any particular substance belongs, by suffering certain colourations when brought in contact with it, these changes being the result of chemical ones, by which the combinations previously existing among the colouring matter of such paper are ruptured, and new ones superinduced.

The terms alkalinity and acidity, therefore, have a signification expressive of condition, and their real meaning is only this, that, as applied to any substance, they indicate a tendency in such to form combinations with acid or alkaline bodies, as the case may be. Neutrality, however, has a relation more to the breaking-point (if I may so term it) of these combinations in the litmus-paper, than to absolute condition of the substance tested; for it is easy to conceive that a substance may be acid or alkaline, and still, by reason of the feebleness of either of these characters, be unable to overturn the combinations referred to, and so manifest either of these reactions.

I only point this out that I may not be misunderstood in the use I make of the term neutrality, and not for the sake of opening a question, as I do not attempt here to remove the neutral point thus arbitrarily located to a position nearer to the true one, preferring to take up ground less subject to criticism, and of more immediate interest, viz., that set forth in the heading of this paper, to which, after the above necessary explanations, I now address myself.

These reactions being in general so easy to obtain in the case of bodies capable of manifesting them, I may perhaps be deemed hypercritical when, in the course of this statement, it is found that my remarks tend to show that the condition of certain of these bodies, as demonstrated by such tests, has been misstated in our popular works on chemistry, and that this has tended inferentially to involve us in further errors relative to the numerous substances chemically allied thereto; at the risk of being thought so, however, I do not hesitate to make the following remarks, and the exact condition of such bodies shall be the principal subject of this paper.

The ores I particularly object to as having their true characters in these respects misstated, or inferentially liable to be misapprehended, belong to a class of salts insoluble, or nearly so, in water. They are the carbonates, borates, silicates, phosphates, and arseniates of the alkaline earths (lime, baryta, strontia), also of magnesia, silver, and lead. Theoretically, they should be *alkaline*, from the following considerations.

Taking an equivalent of any of these bases, and combining it with one of sulphuric or any of the stronger acids, we have a salt corresponding to those of the alkaline mono-sulphates in being *neutral*. Thus, under these conditions, the bases referred to are, equivalent for equivalent, equal in degree of alkalinity to that of the alkalies (potash, soda, &c.), and, therefore, the corresponding salts of these two classes throughout should possess one common character in respect to this particular reaction.

Now the alkaline carbonates, borates, and their common phosphates, &c., give a very decided alkaline reaction with litmus-paper properly prepared; they are indisputably *alkaline*, but the corresponding salts of lime, strontia, &c., are, as a rule, accepted either from experimental results direct, or from inferences based on them, as being neutral, although, from the above considerations, they ought to be alkaline.

The importance of ascertaining which of these two assumptions is correct is obvious, for, if these salts are in reality neutral, we learn, and must take cognisance of, a radical difference existing either in the acids or the bases of which these salts are made up, according as the other portion of the salt is possessed of powerful or weak affinities. In such a case lime, for instance, would not retain the same degree of saturating power (quantivalence) through all its combinations with the acids, the degree of this in any case being determined by the strength of the acid employed; a strong one being thus necessary, as it were, to draw out its highest capabilities in this respect.

Our recently acquired knowledge of the mobility (if I may term it so) of the component molecules of bodies in respect to each other, even in the case of simple elements, and the great tendency many of them manifest to form *intercombinations* among themselves, dispose us favourably towards a belief which, by ascribing a variable potentiality of this nature to these bodies, explains away the apparent anomaly I have just referred to as pertaining to them in their present reputed condition, and make it very desirable to have experimental results, by which to enable us to decide between theory and our present belief. Results, therefore, having for their sole purpose this object I now relate, from which it will be seen, I think, that theory is in this case our safer guide.

The ground taken up by these results has been already just broken in upon, as will perhaps be remembered, in a communication to this Society, entitled "The Alkalinity of Carbonate of Lime," and while the criticism which it evoked has been already useful in stimulating me to this inquiry, it will be useful again, but in a different manner, by supplying us with a knowledge of the precise conditions deemed necessary, by a well-known chemist, to insure reliable indications when testing substances generally in respect to their behaviour with the test I am employing—litmus-paper. Using the precautions recommended in this criticism, I prepared the test (litmus-paper) for use by simply washing it in water free from ammonia till it acquired a pale violet colour, in which condition "it is a delicate test for either acids or alkalies."

Thus prepared, the test, when pressed upon them in a moist state, indicated the conditions of the following substances to be as stated below:—

Alkaline.	Acidic.	Neutral.
Carbonate of magnesia (magnesite).	Phosphate of alumina (wavellite).	Quartz.
Carbonate of lime (calcareous spar).	Phosphate of zinc crystallised.	Clay (purest washed)
Carbonate of strontia.	Phosphate of iron (proto- and sesqui-).	Clay slate.
,, baryta.	Arsenite of zinc.	
,, lead.		
,, silver.		
Borate of magnesia (datholite) crystallised.		
Tribasic phosphate of lime crystallised.		
Tribasic phosphate of magnesia.		
Apatite.		
Phosphate of silver.		
Silicate of magnesia (olivine).		
Silicate of magnesia (serpentine).		
Mica.		
Felspar.		

* Read before the Wellington Philosophical Society.

If the terms acidity and alkalinity have any meaning, or if the test here applied to discover these properties is trustworthy, we cannot refrain from classifying those substances specified in the first and second columns of the foregoing table as alkaline and acidic respectively.

That the test used is trustworthy, in the case of alkalinity at least, and these results consequently so far correct, is in the highest degree probable, from the fact that it has been approved of, and I may say recommended, for this latter object, by one who attempts to demonstrate the condition of neutrality in a case for which, as aforesaid, I have assigned alkalinity.

The correctness of this table being allowed, we may safely and largely add to it by filling in with those salts analogous in chemical composition to the ones stated, or we may at once deduce from it the following general conclusions :—

(1). That those salts of the earthy oxides, as also those of the oxides of silver and lead, which contain single equivalents of carbonic, phosphoric, arsenic, or boracic acids, are alkaline.

(2). That the common silicates of these oxides are also alkaline.

(3). That the salts of the sesquioxides and the remaining metallic protoxides are acid when containing one equivalent or more of phosphoric or arsenic acid.

(4). That the silicates of the sesquioxides are neutral.

The salts of the oxides, therefore, enumerated under the foregoing Nos. 1 and 2 appear to agree, in respect to the characters under investigation, with the corresponding salts of the alkalies; the oxides themselves, as compared to those of the so-called alkalies, thus exhibiting an equal alkalinity through all their combinations, and therefore each oxide is, as far as we can judge, similar in molecular arrangement throughout all such combinations.

In the case of those salts comprised in section 3, it is seen that they compare with the sulphates and chlorides of the same or corresponding bases in being *acid;* but the degree of this acidity is, we know, dissimilar, and may be inferred from the character of alkaline salts with these acids respectively, which has been already described.

The facts above stated have a great significance in respect to the relative potency of the alkalies as compared with that of the alkaline earths; thus, the perfect equality of the bases magnesia and lime as compared with potash (equivalent for equivalent) in respect to alkalinity (here shown) will, if fully recognised, oblige us to dispute the title which this base now holds—that of being the most powerful of any we are yet conversant with.

In reality, lithia has far better claims upon this position, as having the lowest combining number, and being, equivalent for equivalent, undoubtedly equal to potash in basicity, it has, therefore, for similar weights, the greatest saturating power for acids.

Next to lithia is magnesia, then lime, soda, and *afterwards* potash. In this connection it is proper to remark that lithia is the only base which readily attacks platinum when fused upon it—a pretty good test of strength, one would think, and proving, as far as a single result has weight, that the relative position I here assign to this base is correct.

Both potash and soda, however, have certainly an appearance of being far more powerfully alkaline than any of the bases just compared with them; but this is due simply to the fact that they dissolve in water to a larger extent, and with far greater speed than these bases, whereby they are enabled to act with greater facility, and effect more, in a given time.

The fact is that, in our use of the term alkalinity, hitherto we have not expressed absolute potentiality, but rather energy or speed of action, and this speed being dependent (other circumstances being equal) upon the degree of solubility in water of the substance tested, we have thus unconsciously perverted the true meaning of the term (alkalinity), by making it denote a certain degree of solubility—a quality which we do not know is the least related to it.

It only remains to notice that, in relation to rocks, the terms basicity and acidity have, by the facts above stated, their significance enlarged, and their appropriateness rendered still more apparent than before, while the term neutrality is now shown to be predicable of certain of them, and to be equally significant.

The character of rock masses, or portions of them, in these respects may be discovered in a very direct and simple manner, by just pounding a portion of them upon litmus-paper moistened and properly prepared, when, according to the results and manner of sampling, we know off-hand the true condition of the specimen as a whole, or of any particular portion of it; and, knowing this, we learn at once the general affinities of such rocks or portions of rocks, or to particularise whether they are absorbent of acid silicates or silica, or of basic silicates (as the earthy or alkaline ones), or whether, as in the case of clay or clay slate, they are negative to both these classes of bodies.

I may add, in conclusion, that the *rationale* of the new process for the retention of the fertilising constituents of sewage by means of phosphate of alumina is readily explicable by the fact that this is an acid salt (see table); it is thus enabled to chemically absorb all the more basic organic portions of such sewage, these being generally the most valuable for manure, as they are, I believe, the most noxious to animal life.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 15th, 1873.

R. Angus Smith, Ph.D., F.R.S., Vice-President, in the Chair.

Mr. William Thompson was elected an Ordinary Member of the Society.

The following letter from Mr. William Boyd Dawkins, F.R.S., was read :—

As Secretary of the Committee of the British Association for carrying on the exploration of the Victoria Cave, I am obliged to notice the "Notes on Victoria Cave," by Mr. W. Brockbank, published in the *Proceedings*, March 10th, 1873, pp. 95 *et seq.* The notes in question are based partly on Mr. Brockbank's examination of the cave during two visits, with an interval of two years between them, partly on the facts recorded by Mr. Tiddeman and myself, and partly on a ground plan constructed by our superintendent, Mr. Jackson, for the Exploration Committee, that is not yet published. I submit that, until the work of the Committee to which the cave has been handed over by the kindness of the owner be finished, and the observations, to which Mr. Brockbank has had no access, be recorded, his notes must of necessity be imperfect and liable to error. How much he is in error as to matters of fact may be estimated by the examination of the statement, p. 97—"the day before my visit a mass of at least 100 tons had fallen from above the face of the Victoria Cave." Mr. Jackson writes me that not even a mass weighing 1 ton, although two blocks possibly of 10 cwts. each, had fallen. The statement at p. 96, in which I am made to differ with Mr. Tiddeman as to the presence of the pleistocene mammalia inside the cave, is altogether unfounded, and the inference that I "varied my description" after my paper came before the Society is negatived by the fact that the abstract in question was printed for private circulation in 1872. The remains occur at the entrance and extend both inside and outside the cave, as

I pointed out in my diagram. These are merely two out of many points which have been raised, and which do not lead me to alter my conviction that the stratum containing the mammalia is of pre-glacial age, or to undertake any responsibility as to the views which I have *not* advanced. Were I to discuss all the points which have been raised, I should anticipate the Report of the Committee to the British Association. If these hasty and necessarily imperfect observations were not calculated to throw discredit on the Exploration, I should not trouble the Society with this note.

"*On some Improvements in Electro-Magnetic Induction Machines*," by HENRY WILDE, Esq. An abstract of this paper will appear in an early number of the CHEMICAL NEWS.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

Extraordinary Meeting, December 11th, 1872.

JOSEPH SIDEBOTHAM, F.R.A.S., in the Chair.

MR. JAMES M. SPENCE exhibited a large and interesting collection of natural history and other objects from Venezuela. Mr. Spence had lately returned from that country, in which he spent eighteen months, during which time he accumulated a very extensive collection.

The natural history collection contained a number of hunter's skins of the larger animals of prey and of the chase; but the great wealth and beauty of the fauna of the country was best illustrated by the extensive collection of birds, which is probably the best ever got together, and embraces examples of nearly all the tribes found in the Venezuelan Republic.

The economical portion of the collection was of great interest and value, chiefly from its extent and the care which had been exercised in its collection and transportation, and the valuable notes of Dr. Ernst of Caracas, which accompany it, rendered it still more valuable. Specimens of the vegetable and mineral productions of Venezuela were to be seen in great number and variety.

Among the plants exhibited was a small collection of *Characeæ* named by Dr. Ernst, but the chief interest was in a small collection of plants gathered by Mr. Spence on the summit of Mount Naiguati.

This mountain, whose altitude is nearly 9,500 feet, is the highest in Venezuela, and was regarded as almost inaccessible until Mr. Spence and five companions made a successful ascent in April, 1872. A species of grass allied to the bamboos, and new to science, was one of the results of this ascent.

The exhibition also included an assortment of interesting curiosities of native manufacture, recent and ancient. There were goblets, drinking cups, and flasks more or less finely carved out of cocoa-nuts, some mounted in silver; and a series of delicately-worked cups and bowls of calabash.

From the State of Trugillo, Mr. Spence has brought three curiously-shaped vessels obtained from Peruvian burial places.

The collection remained open to the public for some days, and was visited by a large number of persons.

January 27th, 1873.

Professor W. C. WILLIAMSON, F.R.S., President, in the Chair.

"*Description of Minerals and Ores from Venezuela*," by JOHN PLANT, F.G.S.

The collection of minerals acquired by Mr. J. M. Spence during his residence at Caracas, and on several journeys along the coast, came from the provinces of Barcelona, Bolivar, Carabobo, and Coro, with a few obtained from the regions of the river Oronoco and Lake Maracaibo. The collection contains gold in quartz of very rich character, argentiferous ores, green and blue carbonates of copper, copper pyrites, galena, iron ores of various kinds, carbonaceous minerals, calcites, silicas, and rock specimens of gneiss, mica, talc schists, kaolin, hornblendic rocks, and serpentine, with a few imperfect fossil and silicified woods.

The gold quartz of the richest kind came from the province of Guayana, where vast regions of auriferous rocks occur; and where also gold is found in small grains, flakes, and nuggets of all sizes from an ounce to many pounds weight, in a clay from 2 to 8 inches thick, as well as in a red peroxidated iron earth, both probably alluvial drifts. The quartz veins are richly impregnated with gold in crystals and strings, as may be seen in specimens in the collection. Other specimens of the gold rocks come from the Isle of Aruba, and Loro Estado, Tacasumino.

The argentiferous ores are galenas and cupriferous, and are not of very great richness; they are from La Guaira, Cumanâ, and Coro, where decomposed galenas are worked for silver.

The copper ores include twenty specimens from mines that have been worked with profit, one of which, the Aroa mines in the province of Yaracui, is the most famous for the superior richness of its carbonates. The specimen of cuprite from this mine or Quebrada has some long and beautiful crystals of olivenite with cubes of strontian, and from Aragua are specimens of pyrargyrite or red silver ore; others from Caracas, Coro, and the river Tui, include malachites and a native sulphate of copper, probably a crystallisation from the waters issuing from the mines. The chalcopyrites are neither numerous nor very good; the best comes from the Aroa mines, the small granular pyrites appears to be most abundant in a decomposing gneissoze rock.

The galenas are from mines at Los Teques, Aroa, and Campano; several are pseudomorphous crystals in filmy aggregations, interesting specimens for the mineralogist.

The iron ores include specimens of pyrites (mundic) which in Venezuela appears to be as abundant as in most palæozoic regions; ten of the samples are rich, and would be profitable if the cost of mining is not too expensive at Barquisimeto, Caracas, and the Aroa mines.

The hæmatites include specular, micaceous, and red iron ores, all comparable to the best European ores. The limnites comprise bog-iron ore of recent formation and a brown amorphous ore. The siderites include an aggregation of tabular crystals from Caracas, probably a carbonate of protoxide of iron valuable in making steel, and massive clay ironstones from the districts of Corui Machate, where coal is also worked. The crystallised and compact magnetites come from the same place. A thin vein of brown siliceous ironstone has its surfaces covered with minute fragments of clear quartz, singular and beautiful under the microscope.

The carbonaceous minerals are coals, graphite, sulphur, asphaltum, and petroleum. The coals are from Nuevo Mundo, where Mr. Spence has proved the existence of workable coals, the Island of Toas in the Lake Maraciabo, and a cannel coal from Coro, with several black shales from these localities. These coals are undoubtedly of excellent quality, and from report can be worked economically; their age is at present unknown, from the want of any proper geological survey, and in the absence of fossils of any kind in the shales in this collection; in all probability, however, the Venezuelan coals are of true carboniferous age.

The graphite from Caracas is an impure, amorphous, earthy kind, in schists of 2 inches thick, occuring in talcose and micaceous rocks. The sulphurs are massive and of good quality from Campano, Cumanâ, and Coro. Asphaltum and its varieties are reported to be found on the coasts in great deposits and in springs: the specimens in the collection are of excellent quality.

The twelve rock specimens of quartz crystals include some of equal purity and size to those obtained from

Brazil. The marbles are of inferior quality and quite devoid of colour and beauty; but in the International Exhibition of 1862 some excellent green and red marbles were shown.

The predominating rocks of the mountain ranges in Venezuela are palæozoic, metamorphosed talcose and chloritic slates, with great layers of gneiss; and within this range along the line of faults and in veins, are found an endless variety of minerals, of which the collection contains asbestos, serpentine, talc, hornblende chlorite, kaolin, felspar, and selenite.

Amongst the comparatively recent rocks are stalactites, salt, marl, alum, gypsum, and many calcareous deposits from the sea shores and fresh-water lakes.

The special collection made by Mr. Spence during a visit to the Island of Orchilia is interesting to the geologist. It contains sufficient specimens to decide the main geological character of the island to be entirely metamorphic gneiss, overlaid with modern calcareous tufas.

The collection includes a number of crude guanos, phosphates of lime, alumina and *urao*, a sesquicarbonate of soda—all of commercial value, and sources of prosperity if efficiently worked.

February 24th, 1873.

Joseph Sidebotham, F.R.A.S., in the Chair.

Joseph Sidebotham F.R.A.S., exhibited an old microscope sent by Mr. Rideout, and explained its construction. The workmanship of the brass-work was very beautiful, and the various motions and appliances much admired. He also read a letter from Mr. Dancer, who for several reasons thought that the microscope was not more than 120 years old, and was made by the elder Adams. He said that many of these old microscopes, in finish of brass-work, good fitting, and screws, would compare very favourably with instruments of recent construction, and that the appliances and apparatus of one of the complete microscopes would surprise a microscopist of the present day; he would find many parts and adaptations which are generally supposed to be of modern invention.

The stand of the microscope is of ebony, and is a fine specimen of geometrical turning. The optical part is of course very poor, and inferior to the very cheapest achromatic instrument of the present day.

Adulteration of Food Act.—The following is the Report of the Analyst, Thomas Stevenson, M.D., to the Vestry of St. Pancras, Middlesex, for the quarter ending March 25th, 1873:—"In accordance with the 7th section of 'An Act to Amend the Law for the Prevention of Adulteration of Food and Drink, and of Drugs,' I beg to submit to you this, my first report. As my appointment dates only from February 1st, 1873, and operations were not commenced until I had received instructions from the Sanitary Committee, this report really refers to a period of half a quarter. The following is a tabular statement of the articles analysed by me during the quarter under notice:—

(1). Articles of Food—		
Bread	34	samples.
(2). Articles of or for Drink—		
Tea..	13	,,
(3). Drugs	0	,,
Total	47	,,

Of the samples of bread, eight were in my opinion adulterated, and twenty-six not adulterated. The adulteration consisted in every case in the admixture of alum, a substance used for conferring whiteness and improved texture on loaves made of inferior flour. I am of opinion that the habitual use of alum in bread is deleterious and injurious to health; hence my certificates embodied a statement to that effect. Of the eight adulterated samples, three were duplicates procured by the instructions of the Sanitary Committee from bakers who had previously sold adulterated bread. In all, four samples were thus analysed a second time. In three instances, the second samples were found to be again adulterated, though to a very modified degree; and in the fourth instance, the adulterant used (alum) was present to such a trivial extent that its presence might have been accidental. In view of the above circumstances, I did not feel called upon to recommend any prosecution for the adulteration of bread. I trust that those bakers who had adulterated may be warned by samples having been procured for analysis, and that they will cease to adulterate so important an article of diet as bread. The quality of bread analysed was in all cases household bread, sold by weight, at from 6½d. to 8d. per 4 lb. loaf. Of tea, four samples were in my opinion adulterated, and nine not adulterated. In one case, the adulteration consisted in the admixture of a gritty earthy matter ingeniously rolled up inside the tea-leaves, so that to the eye the tea had a clean appearance. A second sample of (this?) tea was procured, but the adulteration had disappeared. Had the tea been again adulterated, I should have advised prosecution. The three other adulterated samples were mixed with leaves other than tea leaves, the foreign leaves being broken up, so as in a great measure to prevent their identification. Two of the samples were similar samples procured from the same shop. A duplicate sample will also be procured from the shop from which the third sample came, and will be reported on next quarter. The teas analysed were common and inferior black teas at 2s. per lb., and tea-dust at from 1s. 4d. to 2s. per lb.; such teas as are purchased by the poorer classes of the population. I did not in any case advise a prosecution for the adulteration of tea; for, in the first place, I did not feel clear that the adulterations had been executed in this country; and secondly, the adulterations were not injurious to health. Nor were the added substances in large amount. It must not be supposed that, because I have not hitherto advised any prosecution, that I in any way intend to condone adulteration. A very recent decision of a magistrate clearly shows that a non-injurious mixture is illegal. When the Act becomes well-known, I shall feel it my duty to advise prosecution in all cases where I believe the admixture to be fraudulent. Of the samples analysed, forty-six were purchased by the Inspectors and one by a private purchaser. This was a sample of bread brought to my house in an irregular manner on the first day of my appointment. I did not feel justified in refusing to analyse the sample, though I gave no certificate, no fee having been paid. It will be observed that I have thought it right to commence my analyses with the common food of the common people. I here tabulate the results of the analyses:—

Nature of Sample.	Number of Sample.	Unadulterated.	Adulterated.	Nature of Adulteration.
Bread	34	26	8	Alum in all cases.
Tea	13	9	4	Grit, 1; foreign leaves, 3.

The Inspectors have, I believe, ably carried out your instructions, and have met with no difficulty in procuring samples, as they inform me impartially from the vendors of the articles analysed.—Sanitary Department, 10, Edward Street, Hampstead Road, N.W., April 1st, 1873."

Fusion of Platinum.—M. Violette communicates the fact that he has succeeded in fusing platinum. The draught of the furnace employed was very powerful, and the Hessian crucibles employed for the purpose, though lined with plumbago, were partially fused. The results of the experiments were stated as follows:—In a crucible of this kind 50 grms. of platinum were placed, partly spongy and partly in fragments, and after an hour's stay in the furnace the crucible was withdrawn, and at the bottom there was found a perfectly melted button of platinum of the same weight.—*Journal of the Franklin Institute.*

THE CHEMICAL NEWS.

VOL. XXVII. No. 702.

ANALYSIS OF ANIMAL CHARCOAL.

By ALEXANDER S. WILSON.

IN a recent number of the CHEMICAL NEWS (vol. xxvii., p. 111) a startling statement was made by Mr. T. L. Patterson to the effect that animal charcoal or bone-black, prepared by exposing bones to a red heat for many hours, contains a large proportion of organic matter; while he further affirms that the moisture in the charcoal must not be estimated at a higher temperature than 212° F., because a greater degree of heat would decompose the organic matter.

On the other hand, it has been affirmed by Dr. Wallace that water in new charcoal is only partially expelled at 212°, and that a much higher temperature is necessary for its complete removal; that, of the nitrogen in the charcoal, a minute proportion only exists as ammonia; and that the matter reported in analyses as carbon (nitrogenous) should be estimated by adding to the insoluble carbonaceous matter the amount of nitrogen that has been removed in the treatment of the charcoal with hydrochloric acid.

Having given some attention to this subject, I was induced, by Mr. Patterson's remarks, to make the following experiments, with a view to obtain some more information on the point. A sample of new charcoal (probably of foreign manufacture) was selected, and subjected to the following experiments:—

(1). A quantity of the sample was ignited, and afterwards treated with ammonium carbonate to insure that no carbonic acid was driven off. The loss was found to be 19·02 per cent.

(2). The insoluble in HCl was determined, and the mean of several experiments gave 13·20 per cent. This insoluble was ignited, and gave 2·35 as the mean percentage of ash or silica; this, subtracted from the former amount, gives 10·75 per cent of what is usually reported as carbon.

(3). The amount of nitrogen in this so-called carbon was estimated, and found to be 0·39 in 100 parts of charcoal.

(4). The total quantity of nitrogen in the charcoal was found to be 0·52 per cent.

(5). The water was estimated directly, in an arrangement by which a current of perfectly dry air was passed over a weighed quantity of the sample, placed in a platinum boat in a tube which was heated during the experiment. This air was then deprived of the moisture it had taken up from the char by being passed through a chloride of calcium tube. Three careful experiments gave, respectively, 7·42, 7·45, and 7·57 per cent. In two of these experiments, a small Bunsen was used to heat the tube containing the boat with the char, and in the third an argand; but in none of them could the heat have been sufficient to convert any hydrogen that might exist in the char, either free or combined, into water; and further, as the amount of hydrogen in charcoal is always very minute, there could not be much chance of error from this cause. The calcium tube was small and of that form in which most of the water is received into a bulb, and does not pass into the solid chloride. The water was in this case removed from the bulb and examined; it was alkaline, and gave, on evaporation, a distinct residue of organic matter, too minute, however, to affect the balance, and consequently to impair the accuracy of the above results.

(6). Another quantity of the sample was treated in the same manner as that in the above, except that the current of air from the char was passed through dilute HCl. The amount of ammonia absorbed was found to be 0·05 per cent, so that, even were the whole of this amount retained by the calcium chloride, the above results (5) would only be lowered by 0·05 per cent.

				Per cent.
(7). The loss of weight at	212° F.	in 5	hours was	4·73
,, ,,	350°	,, ¼	,,	6·10
,, ,,	360°	,, ,,	,,	6·45
,, ,,	500°	,, ,,	,,	7·53

These results appear to show that Mr. Patterson's "organic matter" consists chiefly of water, which is not expelled at 212°.

The method of analysis pursued gives the following results:—

Insoluble carbonaceous matter..	10·75
Nitrogen removed by dissolving in acid	0·13
Carbon (nitrogenous)..	10·88
Water by direct estimation ..	7·48
Unaccounted for..	0·66
Loss on ignition	19·02

According to Mr. Patterson's method, we should have—

Carbon, including some insoluble organic matter..	10·75
Organic matter dissolved	3·54
Water at 212°	4·73
Loss on ignition	19·02

Further estimations of the insoluble, obtained by treating the charcoal with caustic soda to dissolve the so-called insoluble organic matter, show that this organic matter is nearly, if not absolutely, equivalent to the 0·39 of nitrogen found in the insoluble, and that any other insoluble organic matter must be very inconsiderable indeed. This agrees with Mr. Patterson's experience, for he says that only a small portion of the organic matter is insoluble in acid.

Any organic matter, then, other than nitrogen, that may be found in charcoal must consist chiefly, if not entirely, of the constituents of bone-tar, and traces of ammonia which must necessarily be retained from the distillation of the char; hence arises the necessity of washing and reburning charcoal before employing it in sugar refining. I may add that previous experience gives a larger proportion of nitrogen in new charcoal than was found in the sample selected for the present experiments.

A FEW FACTS CONCERNING BLEACHING-POWDER.

By GEORGE E. DAVIS.

NEVER was there such a difference of opinion over any material of common occurrence as over the constitution of bleaching-powder. While we have one chemist giving it the formula $CaOCl_2$, another demonstrates clearly that it contains two molecules of constitutional water; but this formula is denied by others, who imperatively assert that this extraordinary compound is really but a mixture of calcium chloride and calcium hypochlorite, and that formula given generally excludes any constitutional water; but later still, after keeping these formulæ for a number of years, another chemist tells us that it is composed of 2 molecules of calcium chloride, and 1 molecule of calcium hypochlorite. Now, leaving criticism to abler heads, I beg to state the results of a series of experiments I undertook in 1872, in reference to a difficulty which occurred in the manufacture of bleaching-powder; but first I will state the methods I employed for making the various estimations.

The *active chlorine* was estimated by a solution of arsenious acid, and duplicate analyses were made by

Bunsen's method with iodide of potassium, and estimating the liberated iodine with sodium hyposulphite. Another portion was taken and, after digesting in water, hydrogen sulphite was added in slight excess. At first I boiled the solution to expel the excess of hydrogen sulphite, but as I fancied there was a possibility of losing traces of hydrogen chloride, that method was discontinued, and the excess of hydrogen sulphite was eliminated by oxidisation with potassium permanganate, the solution was then made neutral, and the *total chlorine* estimated with silver nitrate and potassium chromate as an indicator.

Three estimations were made of the lime; first, that which entered the solution; second, the lime in state as hydrate; and thirdly, that which was in combination with the carbonic acid.

A weighed quantity of the bleaching-powder was taken and ground as fine as possible with water, and let digest with frequent shaking for twelve hours; it was then poured upon a filter, so arranged that it was washed without exposure to the air. The washing was stopped when the filtrate contained only traces of chlorine, as it was useless continuing the application of water when nothing but the slightly soluble lime was being washed out. The active chlorine being destroyed in the solution, the lime was precipitated by ammonium oxalate, and its amount determined by potassium permanganate. The residue on the filter was then boiled in a cane-sugar solution repeatedly until all the calcium hydrate was extracted. The lime in this solution was estimated by the combined oxalic acid and potassium permanganate methods.

Nothing remained now but calcium carbonate, alumina, and ferric oxide, with the silica and insoluble matter (and, as appeared afterwards by the control analysis, traces of lime. The lime combined with carbonic acid was estimated as above, and the carbonic acid was estimated by absorption in A. H. Elliot's tubes, and afterwards weighed. The iron oxide and alumina, and the silica and insoluble matter, were estimated by the ordinary methods.

The lime I experimented with had been slaked, and sieved through a 28 hole sieve; it possessed the following composition:—

Calcium hydrate	94·471
Calcium carbonate	0·836
Alumina	0·629
Ferric oxide	0·159
Water, by difference	3·531
Insoluble (clay, sand, &c.)	0·374
	100·000

Traces of manganese and magnesia.

This lime was taken and placed half an inch deep on a leaden table standing over concentrated oil of vitriol, the cover of the table forming the chamber, and the oil of vitriol standing about four inches deep, luted it; the top of the chamber was about eight inches above the table.

Chlorine was then evolved from commercial 70 per cent manganese and hydrogen chloride, and then passed through two U-tubes containing chloride of calcium fused with a little free lime; the gas then passed through another U-tube filled with very porous calcium chloride, and after being led up a tall glass column filled with small coke, moistened with oil of vitriol, entered the chamber.

The chamber, after having stood for thirty-six hours, was still full of gas, so the sample was mixed thoroughly, and then the following analysis was made:—

Active chlorine	39·760
Total chlorine	39·760
Insoluble matter	0·218
Carbonic acid	1·340
Oxide of iron and alumina	0·500
Water by difference	15·062
Calcium oxide (total)	43·120
Calcium oxide (soluble)	31·622
Calcium oxide (combined with CO_2)	3·389
Calcium oxide (as hydrate)	8·000

These lime determinations were made several times, as I could not account for the large quantity of CaO which the sugar solution would not extract; but as they came very nearly alike each time I came to the conclusion that either the lime existed as an orthocarbonate, Ca_2CO_4, or else that salt was formed when I boiled the hydrate and the carbonate together.

If the lime is taken simply as monocarbonate and calculated from the carbonic acid obtained, and leaving the excess as hydrate, the above would probably represent—

Hydrated calcium chloroxide ($CaH_2O_2Cl_2$)	81·200
Hydrated calcium oxide (CaH_2O_2)	13·287
Calcium carbonate	3·046
Water by difference	1·749
Ferric oxide and alumina	0·500
Insoluble	0·218
	100·000

When this strength was reached, fresh chlorine was again passed into the chamber; but this time the calcium chloride tubes were taken away, so the chlorine was passed only up the coke column moistened with sulphuric acid.

After standing in the atmosphere of chlorine for two days the bleaching-powder was examined with the following results:—

Total chlorine	42·851
Active chlorine	39·051
Lime (total)	43·400
Carbonic acid	1·513
Oxide of iron and alumina	0·524
Insoluble	0·220
Water by difference	11·492
	100·000

This experiment seems to teach that calcium chloride when finely divided gives up its water to concentrated oil of vitriol as the water has decreased, as the difference between the total and active chlorine has increased; and if this is really the case, and if the active chlorine be a constituent of calcium hypochlorite and chloride in the powder, why is it that by prolonged standing over the oil of vitriol a relative proportion of water is not eliminated? Simply because the active chlorine is in combination both with the water and lime; and the only chloride of calcium which bleaching-powder contains is that which is formed by direct combination of the hydrogen chloride (which is carried over mechanically with the chlorine in the manufacture) with the lime. The hydrogen chloride, which is necessary for the formation of the calcium chloride, may not exist originally in the gas; but if the chlorine is moist and warm hydrogen chloride will be formed by the mutual reaction of the water and itself.

After the above experiment was performed, the chamber was again closed and filled up with chlorine, no tubes were placed between the still and the chamber, nor was the coke column used; the gas entered the chamber as it left the still.

The above experiment was performed upon only half the powder, the other half was placed in a stoppered bottle and sealed round with paraffin.

The gas after standing for a day was not absorbed, so the chamber was opened, and the following determinations of the chlorine were made:—

Total chlorine	44·73
Active chlorine	37·87

The other half of the powder was then taken and placed upon the clean table over the oil of vitriol, and the still was charged with a mixture of 4 parts of manganese to 1 of dolomite, with the requisite quantity of hydrogen chloride. After allowing the chamber to stand for two days, it having been filled up with the mixed gas, a sample was taken out and the following analysis made:—

Total chlorine	38·342
Active chlorine	35·710
Carbonic acid	3·313

No further experiments were made with this sample of powder, so the chamber was emptied, and charged again with fresh slaked and sieved lime of the same composition as before.

Instead of luting the chamber with strong vitriol, weak acid of a specific gravity 1·4 was used.

The still was charged with manganese and hydrochloric acid, and the evolved chlorine led through the calcium-chloride tubes as in the last series of experiments. The gas was thus pure and dry, but the dryness was not required, as I only wished to try the action of pure moist gas upon the slaked lime. When the chlorine left the calcium-chloride tubes, it was conducted through a Wolff's bottle containing water kept at a temperature of 17° C. by means of a water-bath; the gas then passed into the chamber.

When the still was exhausted, the chamber was opened, and the powder examined, with the following results:—

Total chlorine	33·867
Active chlorine	31·645
Lime	44·800
Carbon dioxide	0·347

This latter was a light, but rather moist, powder, which rubbed to a putty between the fingers (the rule-of-thumb test for a good powder), whilst that produced by the former experiment would not rub to a paste, although it contained 39·76 per cent of chlorine.

The chamber was again closed, filled up with fresh chlorine in a way similar to the last, and let stand for twenty-four hours. The chamber was then opened, and the powder examined. It contained—

Total chlorine	35·556
Active chlorine	33·333
Lime	43·260
Carbon dioxide	1·046

The powder upon the table was well mixed, and chlorine again passed in, but this time the U-tubes only were used, the water-bottle being taken out of the circuit, so that the chlorine entered the chamber pure and dry.

After allowing the chamber to stand filled as above for two days, the following estimations were made:—

Total chlorine	36·684
Active chlorine	33·560

This fact proves that if a powder is allowed to gain an excess of water (that is to say, a large excess) over and above that which is necessary to form the hydrate of lime, either through too much water being used in slaking, or through the medium of the chlorine itself in the shape of steam, that it is impossible to increase the percentage of active chlorine to any extent by the admission of more chlorine, even though it be pure and dry, and this was perfectly demonstrated by an experiment upon the large scale, which I tried soon after I had arrived at the above conclusion—

The top soft cake from a chamber of nearly finished powder was well mixed, and the following analysis made:—

Total chlorine	36·72
Active chlorine	34·55

About 500 grms. were finely powdered, and placed upon a table in the chamber, which latter was 58 feet in length, 28 feet in width, and 6 feet high. The sample was distributed over a surface of 4 square feet with a fine laboratory sieve, and the gas was then turned into the chamber. In this experiment I expected all the free hydrate of lime to be saturated with chlorine, but the total chlorine only came out 36·84, and the active chlorine remained the same. This experiment was made at a time when the manufacture was carried on in the most reckless and absurd manner possible; the gas was entering the chamber saturated, and often supersaturated, with moisture and hydrochloric acid, and, although improvements in the practical working were being effected, still the introduction of so much steam into the chamber must have influenced the result. Now the presence of so much free hydrate of lime has often exacted from me the query—Does bleaching-powder for its constitution depend upon this large excess of lime? At first sight this seems probable, but on further investigation this probability disappears, without we assign to bleaching-powder a formula in harmony with its complete analysis, and assume that, like many other salts, it is decomposed in presence of water, and split up into those compounds which we find in its solution.

Now the bleaching-liquor of commerce may be taken as illustrating the above—free lime exists not in any quantity, and if the active chlorine be taken and calculated into calcium chloroxide, and the difference between the active and total converted into calcium chloride, nearly all the lime is taken up.

In order to show this, the following is the analysis of a bleaching-liquor, clear, and of a specific gravity 1·13.

Calcium chloroxide ($CaOCl_2$) ..	13·524
Calcium chloride	1·166
Lime	0·392
Manganese	traces
Water, by difference	84·918
	100·000

The next is the analysis of a bleaching-liquor, which turned out to be adulterated with sodium chloride, and this shows how foolish it is for users of this article to *prefer the rule-of-thumb to the rule-of-three*—

Calcium chloroxide ($CaOCl_2$) ..	11·684
Calcium chloride	3·219
Sodium chloride	1·638
Lime	0·028
Manganese	traces
Water, by difference	83·431
	100·000

The specific gravity of this latter was 1·155.

The following are some analyses of commercial bleaching-powder; I only give here samples of over 35 per cent, and made by the ordinary process:—

	I.	II.	III.	IV.	V.
Total chlorine ..	36·40	35·54	38·62	37·76	39·52
Active chlorine ..	35·12	35·00	35·50	35·87	36·11

The above we may consider good samples; now follow some bad—

	I.	II.	III.	IV.	V.
Total chlorine ..	33·86	37·24	30·52	30·90	37·51
Active chlorine ..	30·25	31·33	29·46	27·87	32·30

The next three analyses are samples of powder made by Deacon's patent process; they were taken from casks on the consumer's premises—

	I.	II.	III.
Total chlorine ..	37·78	34·93	39·74
Active chlorine ..	29·72	31·42	31·57

Now, in the CHEMICAL NEWS, vol. xxvii., p. 182, Mr. W. C. Reid states that the powder made by Deacon's process does not part with its chlorine so readily as that made by the ordinary process; would he kindly explain how it is that a sample may be examined from a particular shelf and found to contain, say, 27 per cent of active chlorine, and when next examined it turns out to contain only 20 per cent, or even less. I have had only three samples of bleaching-powder by Deacon's process under my observation, and I have no doubt that Mr. Reid would not have made the assertion if the fact did not exist; but certainly I have failed to regard the greater stability of the chlorine as one of the successes of the new process.

Before I conclude, I should like to mention Muspratt's experiments in connection with the formula of bleaching-powder. Muspratt assigns a formula ($CaOCl.2HO$), or, in a modern formula, $CaOCl_2.2H_2O$; this is 1 molecule of water more than the compound is calculated to in the above analyses. Now there is not water *enough* in the above analysis, even if all was abstracted from the

lime; therefore, I think this formula will not bear looking into, especially as we find that a large excess of water prevents the powder reaching even 35 per cent, and the finished powder contains so much lime, apparently in the uncombined form.

Walsall, April 28, 1873.

ON THE

DETERMINATION OF PHOSPHORIC ACIDS IN PRODUCTS IMPORTANT IN AGRICULTURE AND PHYSIOLOGY.

By M. JOULIN.

The manufacture of superphosphates and the use of artificial manures give rise to transactions of such importance, that commercial analysts are daily called upon to ascertain the value of these products. At first, animal charcoal had so low a value that falsifications were unheard of. As its agricultural worth was discovered, all sorts of matters, black or brown, were mixed with the charcoal, such as peaty clays carbonised. In consequence of these frauds, a laboratory for the analysis of manures was formed at Nantes, of which Professor Bobierre took the direction. As a cheap and rapid method was required, Bobierre adopted the procedure described in his writings, and still known as the "commercial method." It consists in desiccation of the sample, and incineration if needful; solution in dilute nitric acid, precipitation with ammonia in excess; washing, drying, and ignition of the precipitate considered as pure tribasic phosphate of lime. As by degrees mineral phosphates were introduced, this method, barely tolerable for bone products, became utterly untrustworthy. Sophisticators, therefore, bargained that the analysis of their wares should be made by this method. Not only alumina and oxide of iron, when present, but sulphate and carbonate of lime, and even chloride of calcium, were thrown down by the ammonia, and valued as phosphate of lime. In the analysis of a superphosphate by this method, a certain quantity of sulphate will always be found to have accompanied the phosphate. The presence of carbonate is explained by the presence of carbonic acid in the ammonia, or by its absorption from the air during washing. The precipitate also contains chloride of calcium, even when washing has been prolonged till not a trace of turbidity is caused by the addition of nitrate of silver.

The author then gives the result of experiments made to estimate the importance of these various sources of error, independent of the presence of alumina and iron.

A solution of phosphate of soda was taken, measuring 10 c.c., and containing exactly 0·10 grm. of phosphoric acid. An excess of chloride of calcium was added, and the phosphate was thrown down with ammonia free from carbonate. The precipitate was washed with distilled boiling water, first by decantation, and then on a filter, till the washings were not rendered turbid either by nitrate of silver or oxalate of ammonia. The precipitate, after ignition, weighed 0·250 grm., which, if pure phosphate of lime, would contain 0·11724 grm. of phosphoric acid, an error of more than 17 per cent. The precipitate, on re-solution in dilute nitric acid, effervesced distinctly, and the solution was rendered turbid by nitrate of silver. The chances of error in this method are all against the buyer.

A variety of methods have since been proposed, none of which have become general.

Boussingault removes the lime by means of sulphuric acid in presence of alcohol. In the clear filtrate, the phosphoric acid is determined as ammoniaco-magnesian phosphate, by the addition of a salt of magnesia and ammonia after the alcohol has been expelled by prolonged ebullition. If iron or magnesia is present, its precipitation is prevented by the addition of a little tartaric acid. The process is exact, but requires much time and manipulative skill.

It has been proposed to dissolve the substance in nitric acid in presence of a known excess of pure tin. The stannic acid formed, which contains the whole of the phosphoric acid, is washed, dried, ignited, and weighed, deducting from the amount thus obtained the weight of stannic acid yielded by the same weight of tin similarly treated without phosphoric acid. This process, if well managed, gives, in certain cases, excellent results. The presence of sulphates determines an important error in excess.

The method of Chancel, in which the phosphoric acid is determined as phosphate of bismuth, has been adopted by many analysts. It is rapid and easy, and would deserve preference if it were of general application. Unfortunately it is incorrect in presence of sulphates and chlorides, the preliminary removal of which is tedious and delicate. Further, the phosphate of bismuth carries down with it small quantities of alumina and iron, even in presence of free nitric acid. If the acid be much increased to get rid of this difficulty, the phosphate of bismuth is partially dissolved; the method must therefore be rejected.

The determination of phosphoric acid by the molybdate of ammonia process is remarkably exact, but is most applicable to the determination of small amounts of phosphoric acid in presence of large quantities of iron and alumina. In ordinary cases, it is too tedious and expensive.

Otto recognised the fact that, in presence of an excess of tartaric acid, the hydrochloric and nitric solutions of peroxide of iron and alumina are not precipitated by ammonia. It is then possible to separate the phosphoric acid as an ammoniaco-magnesian phosphate on adding a salt of magnesia and some ammonia. If the amount of iron and alumina present is large, the precipitate formed may retain traces of them. It generally contains subtartrate of magnesia, which is converted into caustic magnesia on ignition, and augments the weight of the precipitate. Hence the admitted necessity of re-dissolving the precipitate, and re-precipitating with ammonia along with a little tartaric acid. If lime is present it must be previously removed by means of sulphuric acid and alcohol, or oxalate of ammonia and acetic acid. This method has not been widely employed, on account of its tediousness.

Some years ago, Warington proposed the substitution of citric for tartaric acid, on account of the greater solubility of the citrate of magnesia.

Recently, Brassier has discovered that phosphate of lime is very soluble in citrate of ammonia, and that in consequence the preliminary separation of the lime may be dispensed with. The following is his method:—

The hydrochloric solution of the phosphates is precipitated with excess of ammonia; the precipitate is re-dissolved in citric acid, though the liquid is still maintained ammoniacal. Pure chloride of magnesium is then added in a sufficient quantity to obtain all the phosphoric acid in the state of double phosphate. The whole of it is thus thrown down without a trace of lime. The precipitate is collected on a filter, washed with ammoniacal water, and ignited. This method is, however, only applicable when the substance is free from sulphates, as otherwise sulphate of lime is thrown down in the ammoniacal liquid. Even in other cases the results obtained do not always correspond. To give exact account of these variations, experiments were made, from which the author draws the following conclusions:—

(1). The preparation of phosphoric acid is complete in a liquor containing twenty-five to fifty times as much citric acid as phosphoric, provided that the chloride of magnesium is in excess. The best results were obtained when the weight of the citric acid was twenty-five times greater than that of the phosphoric, and when the mag-

nesian salt was only one-half more than was strictly necessary.

(2). A very large excess of the magnesian salt causes an error of excess.

(3). A very large excess of citrate of ammonia causes an error of deficiency.

(4). Simultaneous augmentation of the magnesian salt and the citrate of ammonia causes the error to disappear. Hence it is quite intelligible that the results of different chemists are apt to differ, as nothing indicates the quantities of the reagents to be employed. The presence of sulphate of lime causes an error in excess which may exceed 2 per cent.

Chloride of calcium, a compound nearly universal in the solutions of phosphatic minerals, is also liable to cause an error of excess.

These imperfections are more decided if oxide of iron and alumina are also present.

The author considers that he has overcome these difficulties by the use of the following precipitating solution :—

Citric acid	400	grms.
Carbonate of magnesia	20	,,
Distilled water	200	,,

When the carbonate of magnesia is quite dissolved, 500 cubic centimetres of ammonia at 22° Baumé are added. The liquid heats, and the rest of the citric acid dissolves. It is allowed to cool, and is made up to the volume of a litre with distilled water, filtering if needful. The solution is permanent; it is decidedly acid, but only heats slightly when mixed with a large excess of ammonia. The precipitate thrown down by this liquid is re-dissolved on the filter with dilute nitric acid, re-precipitated with ammonia, collected and washed anew, ignited, and weighed.

An equally accurate result may be obtained with greater speed by determining the phosphoric acid contained in the precipitate volumetrically, by means of a standard solution of the nitrate of uranium.

(1). All phosphates in an aqueous solution are thrown down by a solution of nitrate of uranium, and the precipitate is perfectly insoluble in water, even if acidulated with acetic acid. It dissolves, however, in dilute nitric and hydrochloric acids.

(2). If the liquid contains ammoniacal salts, the precipitate formed is ammoniaco-phosphate of uranium, containing 2 equivalents of oxide of uranium to 1 of phosphoric acid.

In the absence of ammoniacal salts, but in presence of alkaline acetates, the precipitate has the same composition.

(3). If neither of these two classes of salts be present, the precipitate contains 3 equivalents of oxide of uranium to 1 of phosphoric acid.

(4). The slightest traces of a uranic salt are shown by the formation of a chocolate-brown precipitate when a drop of the solution is placed in the middle of a drop of solution of ferrocyanide of potassium on a slab of white porcelain.

(5). Uranic phosphates held in suspension in water, or very dilute acetic acid, cause no colouration in ferrocyanide solutions.

A. *Preparation of the Normal Solution of Phosphoric Acid.*—A dilute solution of phosphate of soda is precipitated by a solution of sulphate of magnesia, hydrochlorate of ammonia, and ammonia. The precipitate is washed with distilled water containing 10 per cent of ammonia, first by decantation, and then on a filter, and dried at 100°. It is then removed from the filter, and heated to dull redness in a platinum crucible. At the end of the operation the temperature is raised higher. It is then cooled, and the pyrophosphate of magnesia preserved in a well-stoppered bottle. To prepare the standard solution, 3·127 grammes of the pyrophosphate (containing 2 grammes of phosphoric acid) are weighed out, placed in a flat-bottomed flask, in which they are drenched with about 20 cubic centimetres of pure nitric acid. The whole is boiled on the sand-bath for a quarter-of-an-hour, to re-convert the phosphoric acid into its ordinary state. Water is now added, and the liquid is saturated with dilute ammonia until the slight precipitate formed on each addition no longer disappears on shaking. A few drops of nitric acid diluted with 10 parts of water are now added, to re-dissolve the precipitate formed, and the liquid is poured into a test-mixer, and made up with water to 1 litre exactly. The flask in which the pyrophosphate was dissolved is repeatedly washed out with portions of the liquid, which are then poured back into the litre-measure. This solution contains 0·1 gramme of phosphoric acid in 50 cubic centimetres.

B. *Solution of Acetate of Soda.*—One hundred grammes of pure acetate of soda are dissolved in distilled water; 50 cubic centimetres of pure glacial acetic acid are added, and the solution is made up to 1 litre with distilled water.

C. *Solution of Uranium.*—The purity of the nitrate of uranium is tested by dissolving a small quantity in ordinary ether, in which it should be perfectly soluble. To prepare the solution 40 grammes of the nitrate should be placed in a test-mixer, and 500 cubic centimetres of distilled water added. Ammonia is then added till a permanent turbidity appears. This is re-dissolved by means of a few drops of acetic acid; distilled water is added nearly up to the litre mark, and the liquid is set aside for 24 hours. The next day water is added, so as to make up the exact volume of a litre, and the liquid is filtered into the bottle in which it is to be preserved.

In determining the respective value of the standard solutions, it is important that the bulk of the liquid in every experiment should be the same. The addition of the acetate of soda somewhat diminishes the sensibility of the reaction; hence one and the same quantity should always be added. The next step is to find the quantity of solution of uranium necessary to produce the characteristic reaction with ferrocyanide in a given volume of liquid.

To this end drops of the ferrocyanide solution are placed upon a white porcelain plate with the end of a glass rod. These drops should not be more than 5 millimetres in diameter. On the other hand, 75 cubic centimetres of distilled water are measured into a beaker, and a Mohr's burette, graduated into tenths of a cubic centimetre, is filled with the uranium solution. The best way to fill the burette is to plunge its lower opening into the liquid, and suck it up by means of a caoutchouc tube fixed to the top. When the burette is full the liquid is let fall, drop by drop, into the measured quantity of distilled water, stirring after every drop. The end of a glass rod is then lightly moistened with the liquid, and applied to one of the drops of ferrocyanide solution on the porcelain plate. If a slight reddish colouration does not appear in the centre of the drop, more nitrate of uranium is dropped into the water. About ten drops of the solution have to be added before the colouration is produced. A second test is then made, adding to the 70 cubic centimetres of distilled water 5 cubic centimetres of the solution of acetate of soda, and proceeding as above; 20 drops, or 1 cubic centimetre, will now be required before the colouration is produced. This amount is marked on the label of the bottle, and is deducted from the result found in titrating any sample. In determining the value of the standard solutions, 50 cubic centimetres of the phosphoric liquid are put into a beaker of Bohemian glass, and 5 cubic centimetres of the acetate of soda are added. The beaker is then set on a sand-bath, and brought to the boiling-point. Into the boiling liquid 18 centimetres of the uranium solution are poured without testing the liquid. After that it is necessary to test at each half-centimetre till the colouration is obtained. The number of degrees of the burette consumed is then read off. It will often be found that after no colour has been produced, the next half-cubic centimetre will give a deep red. In such a case it is necessary to repeat the trial, testing after every drop when near the point found above, until the very faintest colouration appears. Suppose, *e.g.*, that 21 cubic

centimetres of the uranic solution have been consumed; as 1 cubic centimetre is required to obtain the colouration with the same volume of liquid without phosphate, the amount of uranic liquid which precipitates 0·100 gramme of phosphoric acid is 21 − 1 = 20 cubic centimetres, and each cubic centimetre corresponds to 5 milligrammes of phosphoric acid. For actual analysis it is well to mark the bulk of 75 cubic centimetres, on a sufficient number of beakers.

1st Case.—Phosphates soluble in water and neutral or alkaline. Phosphates of potassa, soda, and ammonia.

Five grammes are weighed and introduced into a flask marked at 100 cubic centimetres. Distilled water is added, and it is dissolved by means of heating and stirring. When the solution is complete, the flask is cooled down to the temperature of the atmosphere, and it is filled exactly up to the mark with distilled water, closed with an india-rubber stopper, and shaken. If the solution is not clear, it is quickly filtered. Should this operation prove tedious, the flask and the filtering-funnel are both covered with a bell-glass, to prevent evaporation. When the liquid is clear 5 or 10 cubic centimetres are taken, by means of a graduated pipette, previously washed with a little of the same solution. The liquid is put into one of the marked flasks, 5 cubic centimetres of acetate of soda solution added, and the volume made up to 75 cubic centimetres with distilled water, and the whole heated to a boil. The nitrate of uranium solution is then dropped in as above, until, on testing, the colour is obtained.

2nd Case.—The phosphate is insoluble in water, but readily soluble in dilute nitric and hydrochloric acids, tribasic and bibasic phosphates of lime, and magnesia and phosphates of iron and alumina.

The substance is powdered, and 5 grammes are weighed out and put in a marked flask as above. A little distilled water is added, and 20 cubic centimetres of dilute nitric acid, applying heat if needful: when the solution is complete it is made up to 100 cubic centimetres with distilled water. It is then shaken up, and filtered exactly as in case 1; 5 cubic centimetres of the solution are taken, put in a beaker, and mixed with 10 cubic centimetres of the citro-magnesian solution, and a large excess of ammonia. The ammonia should give no immediate precipitate, but on stirring a crystalline precipitate of ammoniaco-magnesian phosphate is deposited. It is allowed to settle for 12 hours, and then carefully filtered through paper free from lime and phosphates. The glass which held the precipitate is repeatedly washed with water containing 10 per cent of ammonia, and the liquid each time thrown upon the filter. The precipitate is washed on the filter with ammonia-water. A beaker marked at 75 cubic centimetres is placed under the funnel. The glass in which the double phosphate was precipitated is repeatedly washed with water containing 10 per cent of nitric acid, and the liquid each time poured upon the filter, washing the dissolved precipitate into the flask. The filter is then washed with distilled water. The volume of the liquid in the flask will not exceed 20 to 30 c.c. The liquid is then saturated with ammonia, adding it drop by drop, till the precipitate formed no longer dissolves on stirring. When the liquid remains very faintly turbid, one or two drops of nitric acid are added, to restore the transparency of the liquid. The 5 c.c. of acetate of soda are then added, the liquid made up to 75 c.c. with distilled water, and the titration performed as above. It has been found by direct experiment that the presence of sulphate of lime, chloride of calcium, salts of iron and alumina, whether severally or jointly, has no influence on the result.

We arrive at the following conclusion:—

(1). The precipitation of phosphoric acid with ammonia and magnesia in presence of an excess of citrate of ammonia is an excellent method for separating phosphoric acid from the bases with which it is commonly combined. But if we are satisfied with weighing the precipitate immediately after ignition, we obtain, in the majority of cases, too high a result.

(2). The determination of phosphoric acid with a standard solution of nitrate of uranium, with the precautions pointed out above, gives results perfectly exact when the phosphoric acid is combined with magnesia or alkalies. But if lime, iron, or alumina be present, the results are inaccurate, and generally too low.

(3). By employing the citro-magnesian liquid to separate the phosphoric acid, and the uranic solution to determine it in the precipitate obtained, accurate results are obtained even in presence of an excess of iron and alumina. In a succeeding chapter the author examines the principal applications of the method to the substances most frequently requiring analysis.

THE PHYSOMETER, A NEW INSTRUMENT FOR THE DETERMINATION OF VARYING VOLUMES OF AIR AND OTHER SUBSTANCES.*

(Concluded from p. 216).

THE apparatus described was primarily intended to be used in physiological researches.

In order to estimate the influence of the bladder-membrane on the changes in volume of contained air, the bladder of a large gilthead was filled with air, and the volume of this air, after correction for barometric pressure and temperature, ascertained directly (by weighing in distilled water, &c.), to be 76·403 c.c.

This bladder was put in the physometer-cage, and the cage three several times raised and sunk about 45 c.c. in the cylinder. The positions of the water-column in the measuring-tube are indicated in the following table:—

	Raising. Height of Water-Column in Tube, in m.m.			Sinking. Height of Water-Column in Tube, in m.m.		
	h_1.	h_2.	Diff.	h_2.	h_1.	Diff.
I. ..	12	201	189	201	9	192
II. ..	8	195	187	195	4	191
III. ..	8	193	185	193	1	192

The mean difference, with necessary corrections, is 191·54. Every millimetre of the scale corresponds with 8·022 centims. Hence, the entire difference of air-volume in the bladder in the two positions = 1536 centims., *i.e.*, about $\frac{1}{50}$th of the entire air-volume contained. Now, deducing from this difference, simply in accordance with Boyle's law, the original volume of the contained air of the bladder under atmospheric pressure, this is found 69·81 c.c., a result which is 7·586 c.c., or 10 per cent, lower than the actual air-volume found directly, a difference too great to be attributed to error in method or observation. There is evidently another cause in action than the increasing pressure of the water. The calculation, according to Boyle's law, supposes a free expansion and contraction, whereas the resistance of the membrane must affect the result. This effect becomes most apparent in using a very dry bladder. At first the raising or sinking of the cage produces hardly any change at all in the measuring-tube; as the membrane becomes saturated, the water-column shows more motion; but, even when it is fully saturated, some allowance must be made. From a considerable number of observations, a *coefficient of inertness (Trägheit)* may be determined, at least for bladders of the same fish species.

It was also found that the bladder in the free state expanded and contracted somewhat more, for the same differences of pressure, than when in the body of the fish. The difference in the case of a tench was about 4 per cent.

Another point to be considered was the possible presence of air in the intestinal canal, which might affect the column in the measuring-tube like the air in the bladder. The fishes were opened after experiment; in

* Abstract of a paper in *Poggendorff's Annalen*, by P. Harting.

only two cases were air-bubbles met with in the intestine, and these were too few and small to be of any importance.

From the above, it appears that only an approximate determination of the entire air-contents in the bladder, when raised and sunk by means of the cage, can be made from observing the height of water in the measuring-tube. Still, this does not affect the value of the apparatus in yielding measurements relatively correct and comparable with each other.

As an example of the observations made, a tench, weighing 0·125 kilo., was put in the apparatus, which was supplied with fresh spring water at a temperature of 10°. At frequent intervals during three days (at the end of which time the fish died) the cage was raised and depressed, and observation made of the measuring-tube. Afterwards the fish was opened, the bladder (still filled with air) was taken out, and a series of physometer observations made with it.

It appears from the tabulated results that, although between individual observations there are considerable inequalities, the average difference in the water-column (from raising and sinking the cage) was in the one case 72·7, and in the other 71·9, showing a close agreement.

The volume of air in the bladder (in free air), estimated by direct method, was compared with the volume calculated from the indications of the instrument by formula, and the coefficient of inertness thus obtained was 1·21. On comparing this with the coefficients of other bladders, the coefficient is found, as might be expected, to increase with the size of the bladder.

Lastly, the air contained in the bladder was analysed. Oxygen had quite disappeared. The constituents were—

N	90·6 per cent
CO_2	9·4 ,,

Soon after the fish had been put in the apparatus (at 11 a.m.) the volume of air in the bladder was 14·105 c.c. The animal was very sluggish in its movements, and its breathing was slight and irregular; the impure state of the water from which it had been taken had probably been unfavourable to its health. It continued vertical in the cage. Gradually the respiratory movements became fewer, and by about two hours had almost quite ceased, the volume of air being then 12·152 c.c. In the course of the day, however, the breathing was renewed, and the fish revived; and next day, twenty-four hours after it had been put in the apparatus, the quantity of air in the bladder had risen to 14·821 c.c.; five hours later it was 16·709 c.c.; next morning it was 21·158 c.c. The specific gravity of the fish was thus considerably diminished, and, from the position of the bladder in the body, the centre of gravity was so displaced that the animal could not retain the vertical, but was pressed with its right side against the lid of the cage. If the fish were in the normal state, the superfluous air found exit by the *ductus pneumaticus* (as was observed with several of the *Cyprinidæ*), and the vertical position was recovered. But in the present case there was no such liberation of air, and, by the evening of the third day, the quantity was 21·722 c.c. The breathing movements were again very much enfeebled, and it was evident these would soon cease, on account of the failure of oxygen in the water. It was, however, highly probable that the air in the bladder consisted in great part of secreted oxygen, which, when the gill-breathing ceased, would return to the blood. In the following night the fish died, and next morning it still lay somewhat on one side, but not pressed against the inner surface of the lid. The volume of air had diminished to 14·95 c.c., and, as stated above, there was not a trace of oxygen, but about 0·1 of CO_2.

The above case is instanced as showing the use to which the physometer may be put. The number of experiments made is as yet too small to permit of much generalisation.

As to the question whether fishes possess the power of changing their specific gravity by compressing at will the air in their swimming-bladders, experiment did not furnish a sufficient answer. Only with one of the fish (a whiting) there appeared from time to time a sudden sinking, and then rise, of the water-column, which must be attributed apparently to a change of the volume of air through muscular contraction. But these motions in the tube were very small (2 or 3 m.m.), and the changes of volume indicated are much inferior to those which must be considered as due to a slow secretion or absorption of air through the walls of the bladder.

In the case of a perch, the influence of the gill-breathing on the water in the tube was very apparent, each movement of the gills (when the fish was at rest) corresponding to a rise and fall of the column, so that one might count the respirations without seeing the fish. Sometimes the gills would open a little wider than usual, and this, too, had its effect in greater rise and fall of the column. The sensitiveness of the instrument is thus shown.

Not only fishes, but other animals which contain air, might be experimented on with the physometer. If it were practicable to introduce a nautilus into it, some light might be thrown on the disputed question how this animal rises and sinks in the water.

Another use to which the physometer might be put is that of determining the quantity of air in the lungs of the new born, who have breathed only a short time and then died. The results thus obtained would be much more certain than with the simple lung-probe, as the smallest quantity of air might not only be indicated but measured.

Again, the physometer might be employed to make visible the diminution which takes place in muscles during contraction. The wires of an induction apparatus might be connected with the knobs of the brass rods.

For the observation of simple physical phenomena, the physometer might prove serviceable. Two experiments, similar to those with the bladders, were made with the small caoutchouc balloons which, filled with hydrogen, are often used as toys. In the first, the balloon was but slightly distended with air, and the mean difference obtained in the water column from raising and sinking the cage through 115 centims. was 116·65 m.m., which corresponds to 0·9451 c.c. The air volume, directly observed by weighing, was 36·16 c.c., and the volume, as calculated from the physometer experiment by formula, was 31·55 c.c., showing the proportion 1 : 1·24.

In the second experiment, the balloon was distended so as to have an air volume of 178·83 c.c., or more than four and a half times as much as in the first experiment. The volume, as calculated from a series of five raisings and sinkings, was 131·09 c.c., showing a proportion to the other of 1 : 1·37. A comparison of these results shows that, with stronger tension of the balloon, its resistance and influence on the expansion and contraction of the enclosed air increase.

But caoutchouc itself, as Wertheim showed many years ago, increases in volume when drawn out. His method of measurement (with compasses) could not give very accurate results. M. Villari last year made similar experiments by a much better method, finding the specific gravity of the same band when extended and when unextended. It might, perhaps, be objected that possibly in the extended caoutchouc microscopically small fissures were produced, into which the air entered, and that this was the cause of the change of specific gravity. With the physometer, this change of volume might be easily rendered visible and measured. The following experiment shows this:—

On the bottom of the glass cylinder was placed a weight of 3 kilogrammes. By an iron hook, two rings of vulcanised caoutchouc were attached to it; a second hook, catching the opposite part of the rings, being attached to the end of one of the brass rods. The diameter and thickness of the rings were very carefully measured, and the volume of both was found to be 5506·88 c.m.m. The apparatus having been filled with water, and all bubbles removed, a measuring tube was inserted, on which each millimetre corresponded to a volume of 3·3003 c.m.m. The second brass rod was now pressed down, and thus

the one with the caoutchouc rings raised, till the weight hung free, the rings being extended. The water in the measuring-tube rose about 5 m.m. Allowing the weight and rings to return to their first position, the water column descended to its former height. This was repeated several times, and always with the same result. The increase of volume in the caoutchouc thus indicated was 16·5015 c.m.m., that is, 0·003, or $\frac{1}{333}$ of the original volume. Doubtless with a heavier weight and thinner measuring tube a still greater effect would be obtained.

ON A NEW SENSITIVE FLAME.

By GEORGE J. WARNER, F.C.S.

Permit me to call the attention of your readers to the peculiarly sensitive character of a new gas-burner lately introduced into the market.

As Wallace's burner may not yet be universally known, I append a brief note of its construction.

It consists of a hemispherical chamber, into which the gas is introduced through a cone fixed horizontally at a tangent, the position of the jet with regard to the cone being so adjusted that the quantity of air injected by the velocity of the gas at all ordinary pressures is always the proportion required for its perfect combustion.

The upper part of the interior of the chamber is lined with wire gauze, and from it issue one or more tubes, at which the gas is burned. The burner which I have used had only one tube.

At ordinary pressures the flame is of the colour of a Bunsen burner, but with a central cone, clearly defined, of pure green, whether it be turned high or low. But if the gas be reduced below the ordinary pressure on the main, the flame becomes white-tipped, and there is no longer perfect combustion, as in a defective Bunsen. We then find that the flame is sensitive to sound, to all sound in fact, but to high notes particularly.

I consider this a curious fact, as I believe it has been generally supposed that a high pressure is necessary to produce such a flame.

The first effect of the sound is to elevate the flame several inches, after which, if the sound be prolonged, it shrinks down, producing the same perfect combustion as at ordinary pressures, and this continues as long as the sound.

It would appear, therefore, that the gas at a very low velocity does not carry with it sufficient air, and that the effect of the sonorous vibration is to increase the velocity of the gas so long as the vibration continues; so that by sound, by the rattling of a bunch of keys at a distance, we can bring the flame from a state of "imperfect" to one of "perfect" combustion.

Of course the burner is small, burning only about $1\frac{1}{2}$ or 2 cubic feet per hour; but I have a larger one in course of manufacture, which I expect will be infinitely more sensitive.

Ardwick Bridge Chemical Works,
Manchester, May 5, 1873.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 1, 1873.

Dr. Odling, F.R.S., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, Messrs. William A. Prout and Alfred Payne were formally admitted Fellows of the Society. The list of donations was then announced, and the names of Messrs. Isidore Bernadotte Lyon and John Henry Baldock read for the third time. These gentlemen were balloted for and duly elected.

Dr. H. Sprengel then read his paper "*On a New Class of Explosives,*" in which, after stating that Mr. Nobel's important discovery in 1864 of effecting the explosion of nitroglycerine and analogous substances by means of a detonating charge, had initiated a new era in the history of explosives, he observed that an explosion may be regarded as the sudden release of that force which previously held together the molecules of gaseous matter and explosives as those solids and liquids which can suddenly assume the gaseous state. Heat is usually the cause of this change, so that explosions, as a rule, are simply rapid combustions of compounds which yield gaseous products: the higher the temperature produced, of course the more these gases are expanded, and the more powerful the explosion. On examining a large number of mixtures of oxidising and combustible substances, it was found that mixtures of nitric acid, density 1·5, and nitro-compounds of the hydrocarbons, fired by a detonating cap, were the most effective. A mixture of nitrobenzol, or picric acid with nitric acid, exploded with the greatest violence, comparable to nitroglycerine. In conclusion, the author drew attention to the harmlessness of the materials as long as they are kept separate, and the comparative ease with which they may be mixed. Something is gained even when one only of the components is liquid, and with this object he had proposed the use of porous cakes of potassium chlorate, saturated with a combustible liquid, such as bisulphide of carbon or nitrobenzol. These had been found to be five times as effective as an equal weight of gunpowder in open granite quarries.

The President said they were much indebted to Dr. Sprengel for his account of these explosives, and although extremely interesting from a theoretical point of view, the question still remained as to whether they could enter into competition with those with which we are already acquainted.

Professor Abel said he had witnessed some experiments with Dr. Sprengel's explosives which had been very successful. They no doubt opened out a new field for experiment, although there might be some difficulty in the practical application of corrosive liquids like nitric acid, or volatile ones like bisulphide of carbon. The mechanical state of the explosive had certainly a great influence on the result; for instance, slightly compressed gun-cotton did not detonate readily even if warm, since to obtain a satisfactory result there must be a certain resistance to mechanical motion; but well compressed gun-cotton could be detonated even when wet by employing a small portion of the dry cotton as an initiative; moreover, a low temperature did not in all cases make a difference, frozen gun-cotton detonating readily. When the cotton was so circumstanced that it could resist mechanical motion it was very sensitive to the detonating charge, but when it could yield to mechanical motion it was not sensitive. These conditions had doubtless some bearing in the case of liquid explosives, as might be inferred from the fact that a shell charged with finely-divided gun-cotton suspended in water could readily be exploded by a small detonating charge.

A paper "*On Zirconia,*" by J. B. Hannay, was then read by the Secretary. The author has carefully examined the effect of precipitating zirconia at various temperatures, and finds that when it is formed at a high temperature, a considerable proportion of the precipitate is very difficultly soluble in tartaric acid. This explains the results obtained by Mr. Forbes when examining zircons for jargonium; the supposed new earth, insoluble in tartaric acid, being really zirconia altered by the temperature at which it had been precipitated. Zircons of low sp. gr. were found to contain uranium, iron, cerium, and didymium, besides silica and zirconia. The author also gives an account of the absorption-spectra obtained on gradually heating a borax bead previously saturated with zircon, and to which a little boracic acid had been added. For this

purpose a zirconia light, formed by directing an oxy-hydrogen flame against a cylinder of zirconia was employed, and which the author recommends for spectroscopic purposes, as being extremely good both in the violet and in the extreme red.

Dr. Odling thanked the author in the name of the Society for his instructive communication on a subject which had excited considerable attention some years ago, and which now seemed to be satisfactorily explained. The difference in the sp. gr. of zircons still offered some points for further investigation.

"*A Note on Pyrogallate of Lead, and on Lead Salts*," by W. H. Deering, was then read by the author. After glancing at previous examinations of the lead salts of this acid, the author described the method he had employed in preparing the salt, $3PbO,4C_6H_6O_3$, analysed many years ago by Dr. Stenhouse. An aqueous solution of pyrogallic acid, that had been purified by crystallisation from benzol, was acidulated with acetic acid, and precipitated with acetate of lead, sometimes leaving excess of the acid, sometimes using excess of lead acetate; but in both cases the results of the analyses agreed closely with the numbers required by the formula $3PbO,4C_6H_6O_3$. On examination, however, the precipitate was indubitably proved to contain acetic acid; the amount of which corresponded very nearly to that required by the formula—

$$C_{12}H_{10}PbO_6(C_2H_3O_2)2Pb.$$

The precipitate, therefore, is really a combination of pyrogallate and acetate of lead. The author suggested that several of the organic lead salts said to consist of m molecules of lead salt $+ n$PbO, might really be double salts containing acetate of lead.

The President, in thanking the author, observed that his examination of the lead pyrogallate had an important relation to other organic lead compounds, and thus became a subject of general interest.

Dr. Wright said that on decomposing by sulphuretted hydrogen the lead salts of certain acids obtained from the terpenes he had observed the presence of acetic acid: this he had hitherto attributed to the presence of a basic lead salt.

Mr. Spiller suggested that some light might be thrown on the matter by the mercury salt. Mercury pyrogallate obtained by precipitation with mercury chloride was a scaly crystalline precipitate, an examination of which might give a solution of the question.

Dr. Debus observed that it should be a fundamental rule always to qualitatively examine the nature of any given precipitate, so as to ascertain what acids and bases were actually present, and we were much indebted to Mr. Deering for pointing this out so forcibly.

The meeting ultimately adjourned until Thursday, May 15, when there will be a lecture "On Isomerism" by Dr. H. E. Armstrong.

MISCELLANEOUS.

New Civil Engineering College in Japan. — Dr. Edward Divers has been appointed Professor of Chemistry in the Civil Engineering College just established in Yedo by the Japanese Government. There are also Professors of Mathematics, Engineering, and Natural Philosophy, besides teachers of minor subjects. The students have to matriculate in English. The college buildings are built in European style, and include, besides offices and class-rooms, residences for Professors and 300 Students. The laboratories will probably be fitted up, and perhaps built, under the direction of Dr. Divers.

A New Solvent for Iodine.—I find that glacial acetic acid is an excellent solvent for iodine, certainly not inferior to alcohol. On heating acetic acid with excess of iodine to boiling, and then allowing to cool slowly, beautiful large, slender crystals of iodine will form (sometimes half an inch long). The crystals formed from supersaturated alcohol solution of iodine are short, of arrowhead shape, and by no means so abundant, for glacial acetic acid takes up far more iodine hot than cold. I hope you will make this easily executed experiment, and you will then see the finest iodine crystals yet produced. If saturated alcoholic and glacial solutions of iodine are mixed in equal proportions, and allowed to stand, *acetic ether* is formed. The presence of a little MnO_2 and a drop of SO_4H_2 seems to promote the formation, but is quite unnecessary.—Dr. I. Walz, in the *Journal of the Franklin Institute.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 21, 1873.

Final Reply to P. Secchi.—M. Faye.—On solar physics.

Condensation of Carbonic Oxide and Hydrogen, and of Nitrogen and Hydrogen by the Electric Effluvium.—MM. Thenard.—A mixture of equal volumes of carbonic oxide and of hydrogen was submitted to the electric effluvium; this being the mixture which was formerly given when the electric spark had been passed through an oleaginous mixture containing equal volumes of carbonic acid and protocarburet of hydrogen. The reaction took place more than twice as quickly, an oleaginous mixture of the same aspect being produced, indicating a greater power in the electric effluvium than had been supposed. Next a mixture of hydrogen and nitrogen, in the proportion of 3 to 1, was submitted to the action of the effluvium. In ten minutes traces of ammonia were perceptible by means of litmus-paper, and in two hours they were sensible to the smell. The transformation, however, does not become complete unless an acid is introduced capable of absorbing the ammonia; monohydrated sulphuric acid was employed. Operating on 75 c.c. of gas, kept in circulation, 10 c.c. of mixture were produced in ten hours without acid; and after the introduction of acid 65 c.c. in 13 hours.

Spectral Illuminator.—M. Le Roux.—This is an instrument by which one may vary almost instantaneously the nature of the light illuminating the slit of a collimator. The rays emergent from a prism are received on a movable mirror, and the simple ray required is sent in the proper direction. The prism and mirror, with two collimators in the positions of the incident and emergent rays, are fixed on an articulated parallelogram composed of two lozenge-shaped frames.

Action of Electricity on Flames.—M. Meyreneuf.—Short extract from memoir.

On the Interference Fringes observed with Large Instruments directed to Sirius and several Stars; Consequences which may Result with Reference to the Angular Diameter of these Stars.—Letter by M. Stephan to M. Fizeau.—Some time ago M. Fizeau pointed out, in *Comptes Rendus*, that there was a remarkable relation in most interference phenomena between the dimensions of fringes and those of the luminous source, so that the fringes only appeared where the angular dimensions of the luminous source were almost insensible.

Thus, by observing the fringes formed at the focus of stellar telescopes from separate slits, some new data might be obtained as to the angular diameter of stars. Acting on this suggestion, M. Stephan thus observed one evening a large number of stars, Sirius included, using a telescope with a screen having narrow parallel slits 15 c.c. apart. All the stars gave very intense fringes, those of Sirius, however, being somewhat less distinct. The following evening he used the same telescope with a screen having two lunules placed at the extremities of the same diameter, the inner edges being distant about 50 centimetres. This time Sirius gave no fringes, whatever the magnifying power, while all the other stars gave them. M. Stephan thinks it probable that, though Sirius was somewhat low, this disappearance of fringes was not due to atmospheric influence, but that the diameter of the star will be found not insensible.

Comparison of Electric Machines.—M. Mascart.—An electric machine may be characterised according to two constants—(1) the difference of potential which it is capable of producing between two conductors; (2) the quantity of electricity which it can yield in a given time. The writer has made comparison of eleven different kinds of machine, comprising three Ramsden, one Van Marum, one Nairne, three Holtz, one Carré (with caoutchouc plate), one Armstrong, and the induction coil. A table gives the diameter of the plate, the production per turn, and the production per second.

Condensed "Effluvium" of the Induction Spark.—M. du Moncel.—Reserved for translation.

Influence of Rays of Various Colours in the Spectrum of Chlorophyll.—M. Chautard.—After specifying the changes produced in chlorophyll by light, the writer makes reference to the persistence of green matter in certain plants late in the autumn season; he considers this due to the presence of fatty and resinous matters. He find that a solution of chlorophyll in fixed oils (oil of belladonna, *e.g.*) is not sensibly altered after several days' exposure in full sunlight. The most luminous spectral rays are the most active in changing chlorophyll solution; and rays which have already traversed a layer of chlorophyll have no effect on a second layer so long as the first is not discoloured. In this experiment he used vessels with two or more compartments. Heat modifies chlorophyll, but does not readily destroy it at temperatures under 100°. Above 100° the chlorophyll undergoes various alterations, according to its degree of dryness and the nature of the solvent. Dried chlorophyll is completely disorganised at a temperature about 200°; whereas, solutions of it in essential oils only undergo a slow, gradual change at this temperature, and may even resist 225° or 250° for several hours.

Conditions to be Observed in the Choice of Sources of Water for the Supply of the City of Paris.—M. Belgrand.—An engineering paper. The author seeks conditions under which bicarbonate of lime shall not deposit calcareous incrustations in the mains.

Researches on the Chloride, Bromide, and Iodide of Trichloracetyl.—M. H. Gal.—The material employed in the preparation of these compounds was trichloracetic acid, obtained by treating chloral hydrate with fuming nitric acid. The action of the sun's rays, recommended by M. A. Clermont, the discoverer of the process, is useless. Action of chlorides of phosphorus on trichloracetic acid.—Chloride of trichloracetyl.—This acid was treated with protochloride of phosphorus; reaction was obtained on applying a gentle heat. Hydrochloric acid was given off, phosphorous acid formed, and, on rectifying the distillate, a product was collected boiling at 118° C., which is perchloric aldehyde, and, on treatment with water, gives rise to trichloracetic acid with development of hydrochloric gas. Phosphoric perchloride reacts upon trichloracetic acid with more energy. The chloride of trichloric acetyl is accompanied by oxychloride of phosphorus. The bromide of phosphorus gives corresponding reactions. The bromide of trichloracetyl is a colourless liquid, fuming in the air. If left in an open bottle it soons becomes trichloracetic acid, a change which takes place more rapidly in contact with water. With alcohol, hydrobromic gas is given off in abundance, and, on treating the liquid with a solution of carbonate of soda, we obtain trichloracetic ether. The action of iodine is less decisive, though by means of the tri-iodide of phosphorus a small quantity of a brown liquid was obtained, boiling at 180° C. With alcohol, it yielded hydriodic acid and trichloracetic ether.

Action of Sulphide of Sodium on Glycerine.—M. F. Schlagdenhauffen.—When sulphide of sodium is allowed to act upon glycerine at a gentle heat, a liquid is obtained lighter than water, and having an odour at once ethereal and alliaceous. On heating in a retort on the sand-bath 200 grms. of monosulphide of sodium with 100 grms. of glycerine, water and traces of sulphuretted hydrogen were given off at first. After eighteen to twenty hours, yellowish drops appeared in the neck of the retort, condensing to a light oil in the receiver. The odour of the product recalls at first chloroform and acetic ether. The distillation continues eight hours longer, and the distillate takes an alliaceous odour. On repeating the operation in six retorts, of 1 litre each, 140 grms. of the liquid were obtained, dried by means of chloride of calcium, and submitted to fractional distillation. The first portion passed over limpid between 50° and 70° C., but the boiling-point rose gradually to 200° C. By repeatedly rectifying the first portion, a liquid was obtained, boiling at 58°, sp. gr. 0·825, of an odour recalling that of mercaptan. It was supposed to be hydrosulphate of ethyl, but, on ultimate analysis, its composition was found totally different. Its alcoholic solution precipitates alcoholic solutions of chloride of gold a gelatinous white, nitrate of silver a light yellow, acetate of lead an orange-yellow, and mercuric chloride a white. Nitric acid attacks it with extreme violence, but without yielding the brown oil which is formed in the same reaction with mercaptan. The author is still engaged with the investigation of this compound.

Method of Determining Oxygen in the Peroxide of Hydrogen and in other Liquors by means of a Standard Solution.—F. Hamel.—A known quantity of oxygenated water is put in a suitable vessel, and a standard solution of permanganate of potash is dropped in, the gas given off being collected in a graduated tube. As soon as the water begins to show a colour, the operation is over. The quantity of permanganate employed is read off, and the volume of gas disengaged is measured. The quantity of oxygen, corresponding to 1 c.c. of permanganate, is then found by calculation. A standard solution is thus obtained, which will serve for the direct determination of oxygen in liquids where there are no elements capable of interfering.

Properties and Composition of a Cellular Tissue Found in the Organism of Vertebrate Animals.—A. Muentz.—When the skins of mammiferous animals are exhausted with boiling water, there is left a residue having the original appearance of the skin, but deprived of tenacity. It is formed of conjunctive tissue, mixed with a small quantity of elastic fibres and piliferous bulbs, and retains all the mineral matters belonging to the hide. A characteristic property of this tissue is its solubility in the cupro-ammoniacal liquid of Schweitzer, in the manner of cellulose. It is not attacked by ammonia, but dissolves in it easily in presence of metallic oxides, such as those of copper and zinc. The liquid, neutralised with an acid, deposits flocks, which, when washed and dried, have a horn-like aspect, and retain variable proportions of metallic oxides. The composition of the organic matter is nevertheless constant, whatever may be its origin and the mode of its extraction. It is soluble in ammonia, and also in dilute acids, but only in presence of salts of copper or zinc. Sulphuric acid converts it into glycocoll; with potassa it yields neither tyrosine nor leucine. Its composition

agrees with those of albumenoid bodies. In the subjoined analyses, 1 represents the substance prepared from the skin of a rabbit; 2, from that of an ox; 3, the same, redissolved in ammonia, and re-precipitated by acetic acid.

	No. 1.	No. 2.	No. 3.
Carbon	54·61	54·62	54·37
Hydrogen	6·94	6·72	6·85
Nitrogen	14·48	14·31	—

In an analytical point of view, these researches show the method of isolating certain animal or vegetable principles by submitting them to the action of the following reagents, of progressively increasing energy:—Ammonia, ammoniuret of zinc, and ammoniuret of copper. In this manner, albumenoid matters soluble in ammonia alone are separated from those which, like the tissue of the conjunctive, dissolve in it in the presence of the oxide of zinc. Those matters, again, which are insoluble in the two former liquids, but soluble in cupro-ammoniacal liquid, such as silk, are separated by means of the latter. Other substances of the same group, such as wool, insoluble even in the cupreous liquid, are untouched by any of these treatments.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

DELIVERED FROM OCTOBER 5 TO OCTOBER 11, 1872.

Improvements in treating liquors containing ammoniacal compounds in order to obtain products therefrom. James Young, Kelly, Renfrew, N.B. October 10, 1872.—No. 2988. The feature of novelty which constitutes this invention is the heating in a still or boiler the solution of muriate of ammonia resulting from the production of carbonate or bicarbonate of soda by the ammonia process, mixed with the carbonate or carbonates of lime and magnesia, in order to obtain ammonia combined or mixed with carbonic acid.

Improvements in the manufacture of carbonate of soda. James Young, Kelly, Renfrew, N.B. October 10, 1872.—No. 2989. The feature of novelty which constitutes this invention is the passing of carbonic acid through a solution of sulphuret of sodium, the solution being kept at or near the boiling-point in close vessels.

Improved means and apparatus for drying sewage, and other like substances. William Astrop, paper maker, 27, Oriel Road, Homerton, Middlesex. October 10, 1872.—No. 2991. This invention relates especially to the separation of the liquid from, and the drying of the solid portion of the sewage or other like substance. The solid is separated from the liquid matter by precipitation in the ordinary settling tanks used for such purpose, but preference is given to those in which a partial vacuum is employed under the false bottom of such settling tank. The solids are dried by means of a centrifugal machine, the cage of which may be lined internally with felt cloth, or other suitable permeable material, and which is fitted with suitably arranged and contrived blades or scrapers which prevent the concretion of the solid matter on the sides of the cage. A brush or brushes, made to revolve or reciprocate with the motion of the cage, keep the meshes of the gauze of which it is composed clear of solid matter.

Improvements in obtaining acetic acid. John Steedman, of the firm of Steedman and McAlister, manufacturing chemists, Glasgow, Lanark, N.B. October 11, 1872.—No. 3003. This invention consists in passing the vapour of the impure acid as obtained by processes heretofore in use through a hydrocarbon, or through an oil or fat; such hydrocarbon, oil, or fat being maintained at a temperature at least equal to that of the acetic acid vapour, and sufficient to liquefy it.

Improvements in the treatment of coal-gas tars, for the purpose of obtaining certain useful products therefrom. Charles Lowe, manufacturing chemist, Reddish, Lancaster. October 11, 1872.—No. 3005. This invention relates to obtaining carbolic, cresylic, and other acids from London coal-tar, or similar substances.

Improvements in the separation of substances and products capable of being employed for the purposes of dyeing and printing. Edward Chambers Nicholson, Herne Hill, Surrey. October 11, 1872.—No. 3007. This invention relates to the separation of what is known as rosaniline base from other products and compounds, which are either formed during its formation or subsequently in effecting its liberation. Rosaniline base is obtained, as is well understood, by firstly heating together aniline, videlicit, what is known as commercial aniline, with a solution of arsenic acid, in such a manner as is described in the Provisional Protection granted to me, No. 184, and dated January 25, 1860, or otherwise, in order that the desired compounds of rosaniline base shall be formed, which, together with arsenious acid and the excess of or the undecomposed arsenic acid and other products, will constitute what is technically known as the "melt." The melt thus or otherwise obtained is dissolved in water and the compounds of the rosaniline base, in solution or otherwise, are decomposed by means of a stronger base, such, for example, as lime, and the liberated base is separated from the insoluble products thus resulting by solution in water heated to the boiling-point under the ordinary or normal pressure; the solution of the rosaniline base is allowed to cool, and the crystals deposited are collected and utilised for the production of dyes or colours, as is well understood. The rosaniline base thus or otherwise separated and obtained is found to possess but a slight solubility in water boiling at the ordinary or normal pressure, consequently a very large proportion of water is required to effect the solution of a small proportion of the base. In practice it being found that 1 lb. of the base is obtained from a solution of about 60 gallons of water. Now my invention consists in effecting the solution of the so-called rosaniline base or magenta base obtained or resulting from the processes hereinbefore mentioned or otherwise obtained in water heated under pressure, whereby a greater solubility of such base is obtained, and consequently the amount of water necessary for effecting the solution of a given quantity of such base is very much diminished. In carrying out this invention I take the melted mass resulting from the foregoing or other similar processes and reduce that which is technically known as the "melt" to a rough powder by means of edge rollers or otherwise, and I mix the same, either during such process of grinding or subsequently, with caustic lime, either hydrated or otherwise, and in such quantity as shall suffice to neutralise any acid and liberate the rosaniline or magenta base. Such mixture or product I then transfer together with water into a suitable apparatus or boiler capable of withstanding an elevated pressure, to which I apply heat. The desired solution having been obtained by reason of the elevation of the pressure and consequent increase of temperature. The solution or the contents of the boiler may be transferred, either before or after subsidence, to another vessel, wherein the separation of the rosaniline and magenta base thus extracted may be effected. Should the rosaniline or magenta base not be fully extracted by the first treament by means of water heated under pressure the treatment may be repeated.

Improvements in the method of and apparatus for separating the soluble constituents of substances from the insoluble constituents. Samuel Henry Johnson, F.C.S., chemist, Lea Bank Works, Stratford, Essex. October 12, 1872.—No. 3014. According to this provisional specification the material to be operated on is placed in a suitable vessel, and the solvent is forced upwards through it entering near the bottom and being drawn off near the top. The spent material is then forced out by a plunger through a tubular passage; the compressed material in this passage plugs it and prevents the solvent passing.

NOTES AND QUERIES.

Zinc Powder.—Can you tell me where I can get, or how make "finely-granulated zinc" (as fine, or finer, than Calais sand)?—R. A. R.

Deodorising Naphtha.—Would you be kind enough to state in your next issue if there is any method of removing the smell from naphtha, or torch-oil, without losing any of its illuminating powers or burning properties?—PETER TRUMBLE.

Crystallising Pan for Nitrate of Lead.—Can you inform me what is the best kind of vessel for evaporating a solution of nitrate of lead, in a large quantity, for the purpose of crystallising; and whether the heat of steam, or of fire, direct, is the best for this purpose?—CONSTANT SUBSCRIBER.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society.* By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 7 (referring to Cavendish's experiment).—"Yet, notwithstanding the precautions which he had taken, he still met with some anomalies for which he could not satisfactorily account, and which appear to have affected the results rather more than he had anticipated."

See p. 10 for good description of the room.

See pp. 23-24 for description of the scale and telescope. A good plan.

P. 26.—"The 2 inch and the 2½ inch lead balls were gilt and burnished, in order to prevent any radiation of heat from the surface."

P. 31.—" . . . if the slightest change of temperature be applied near the side of the torsion-box, or if either *side* near the balls be sprinkled with a little spirit of wine, the torsion-rod is immediately put in motion, and the resting-point undergoes a rapid change."

P. 35.—" . . . the mean increase of temperature has been only 0·15° F. per hour. Now, when it is considered that I am always obliged to remain in the room during the whole time of any experiments, and that a lamp is occasionally necessary for observing the microscopes, this change of temperature is of no great amount; nor, indeed, does it produce any anomalous effect on the motion of the torsion-rod. For I have generally noticed that anomalies arising from this source seldom occur except when *sudden* changes of temperature are produced in the torsion-box; and then only when one side of the torsion-box is more affected than the other, which seldom occurs in the ordinary state of the atmosphere."

P. 36.—"Both of these experimentalists" (Cavendish and Reich), "in the pursuit of their enquiries, met with anomalies for which they could not satisfactorily account; and although Cavendish suspected the cause of some of these anomalies, and even undertook a few experiments for the express purpose of discovering it, yet he does not appear, either then or at any future time, to have pursued the subject further, nor to have applied any remedy for the evil in any of his subsequent experiments. He closes the account of his thermometrical experiments with the following laconic remark:—'It seems sufficiently proved, therefore, that the effect in question is produced by the difference of temperature between the weights and the case.' He probably considered that the amount of the disturbing force, although very sensible when tried in the extreme cases which he pursued, yet under the ordinary circumstances of temperature was too minute to lead to

any material error in the results, and therefore abandoned the attempt to remove it; for he says, 'It, indeed, may be objected that, as the result appears . . . . (for this quotation see Cavendish's original paper, Chemical News, vol. xxvii., p. 210) . . . . 1-14th of the whole.' Had Cavendish, however, increased the number of his experiments, he would soon have discovered the error of his opinion, and that it would be absolutely necessary to remove altogether, or at least to modify, this disturbing force before he could place any dependence on the result of his labours."

P. 37.—"Although Reich pursued his experiments in a room which was rather more favourably situate than the outhouse of Cavendish, yet it appears that this distinguished experimentalist also experienced anomalies for which he has not given any satisfactory explanation. Indeed, he does not describe the nature of those anomalies. . . . . But at the end of his work . . . he subjoins the following passage, which bears upon the . . point in question, to which I am desirous of drawing the attention of the reader:—'Totally different from these gradually progressive changes in the times of vibration, and also easily to be distinguished therefrom, were the *still much greater anomalies* that were *occasionally* observed, and which were produced by a small obstruction that was opposed to the vibrating arm. It is probable that small hairs or filaments caused by foulness had introduced themselves into the narrow case, and which immediately produced much shorter periods of vibration, greater irregularities in them, and a rapid decrease of the arc of vibration. *Whenever* this happened, the case was carefully cleaned: that is to say, all the filaments that were in the narrow tube through which the wire that supported the balls passed, were destroyed by means of a burning flame passed through it.' Now, it is difficult to understand how these *occasional* interruptions could have taken place at such short intervals, after the tube had been once properly cleaned and closed; and as no other allusion to such disturbances has been made in the account of the experiments that appear in the book, not only a doubt naturally arises as to the nature and magnitude of the anomalies, and the precise manner in which the results were affected, but a suspicion also is entertained that some of the experiments thus alluded to may have been rejected, on account of their presumed discordance."

MEETINGS FOR THE WEEK.

Monday, 12th.—Geographical, 8.30.
—— London Institution, 4.
Tuesday, 13th.—Royal Institution, 3. J. H. Parker, "On Roman History and Architecture."
—— Civil Engineers, 8.
—— Photographic, 8.
Wednesday, 14th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 15th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Chemical, 8. Dr. H. E. Armstrong, "On Isomerism."
—— Royal, 8.30.
—— Royal Society Club, 6.

THE CHEMICAL NEWS.

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A DISCOURSE ON ALCOHOLS FROM FLINT AND QUARTZ.*

By Professor EMERSON REYNOLDS, M.D.

In appearing before you this evening to lecture on "Alcohols from Flint and Quartz," you will permit me at the outset to explain, and even materially to extend, the title of my discourse.

I do not propose to show that spirits can be extracted from flint and quartz by mechanical processes; but I hope to satisfy you that by indirect and purely chemical means we can obtain from these familiar and widely-diffused minerals, and from native silicates, bodies resembling in chemical action, and even in appearance, the well-known alcohol of wine.

Carbon has hitherto been considered the sole alcohol-forming element; but we shall see that the chief constituent of flint and quartz, namely, silicon, must now be admitted to share in this power, and likewise in the ability to form other remarkable compounds that it will be necessary for me to refer to in the course of this lecture.

In selecting this subject, I have done so in part because this most promising field of research, opened up by the labours of Wöhler, Buff, Friedel, Crafts, Ladenburg, and others, has hitherto been but little cultivated in this country, and therefore probably possesses some novelty for the audience I have the honour to address; and also because we find in this new branch of chemical investigation most interesting illustrations of the advantage we may derive from the cautious use of the argument from analogy.

As a preliminary to the enquiry I propose, we may consider very briefly the chemical nature of flint and quartz.

The word "flint" is of very ancient origin, and was often used to indicate any particularly hard rock. In this sense it is employed several times in the Old Testament—first, in the book of Deuteronomy, viii., 15, and in Psalms, cxiv., 8, where the rock struck by Moses is said to be "of flint." We now use the term to distinguish a well-known uncrystalline mineral, which can be easily shown to be a chemical compound of two so-called elementary forms of matter—oxygen and silicon.

Flint is identical in chemical composition with quartz or rock-crystal, though physically different, as you will perceive by reference to the fine specimens on the table, kindly lent by Mr. Bryce M. Wright, the well-known mineral collector. The common name of "silica" is given to the chemical compound, and the terms flint, agate, quartz, rock-crystal, are reserved for the forms in which we meet with this remarkable substance in nature.

Having cleared our ground so far, we have to find how the oxygen may be separated from any of those forms of silica, and the element silicon may be obtained. This cannot be directly accomplished, but by indirect means we can obtain the desired results. I have here a quantity of finely-divided flint mixed with some powdered fluor-spar; when I pour oil of vitriol on the mixture, and apply heat, a colourless gas is obtained, which, when passed into water, produces a highly acid and gelatinous liquid. The gas is a compound of the element fluorine, with silicon—the tetrafluoride of silicon—and this, when brought in contact with water, produces an acid called hydrofluosilicic and a quantity of gelatinous hydrate of silica.

The clear acid liquid, when treated with caustic soda, yields this white salt, the fluosilicate of sodium, from which we directly obtain the silicon, as you see, by simply heating with some metallic sodium. In this case, the sodium replaces the silicon, the latter separating, as you observe, in the tube as a dark brown substance.

Having thus prepared silicon from flint, we are in a position to compare it with carbon, to trace out the analogies which subsist between them, and then to show that some of the alcoholic and other *compounds* of carbon have their strange and interesting analogues in a silicon series.

First, then, we shall compare the elements themselves.

We meet with nearly pure carbon under the well-known forms of charcoal, graphite, and diamond.

We can easily prepare the corresponding varieties of silicon—the amorphous, the graphitoidal, and adamantine. With the aid of the phengascope, I shall now project on the screen images of specimens, in order that you may compare the varieties side by side. I have also on the table a very fine specimen of crystallised silicon, for which I have to thank Messrs. Hopkin and Williams. [The lecturer showed a greatly magnified image of a fine crystallised diamond on the screen; a number of other specimens were exhibited in the same way.]

As might be anticipated, the specific gravity of carbon is lowest in charcoal and highest in diamond. Corresponding differences in specific gravity are observed between the varieties of silicon. The two elements also correspond remarkably in variations of specific heat, with different states of aggregation. The specific heat of the diamond is lower than that of graphite, and the specific heat of adamantine silicon is lower than that of the graphitoidal variety.

Passing now from the points of physical resemblance between carbon and silicon, I shall dwell more particularly on the chemical relations of the two elements.

We are familiar with the fact that carbon burns in oxygen, producing, in an excess of that gas, the well-known gaseous oxide of carbon commonly called carbonic acid; charcoal or coke burn readily in oxygen, while graphite is consumed with considerable difficulty, and the diamond is still more difficult of combustion. Amorphous silicon burns as easily in oxygen as charcoal, and forms the oxide silica, the same oxide that we find as flint or quartz. [Experiments exhibited.]

In this way we can reproduce, so far as composition is concerned, the substance from which we originally obtained the silicon for our experiments. Now, though amorphous silicon is easily burnt, the graphitic and adamantine varieties of the element resemble the corresponding forms of carbon in difficult combustibility. Crystalline silicon may be raised even to a white heat in oxygen gas without burning.

Unlike carbon, silicon in any of its forms easily combines directly with chlorine, producing the liquid choride which I have in this tube. This is a very volatile body, boiling at 50° C., and is half as heavy again as water. It can also be prepared from silica by heating to full redness the finely-divided oxide and carbon in a current of chlorine. In composition this chloride is the silicon representative of tetrachloride of carbon.

In addition to this chloride of silicon, the discovery of which we owe to Berzelius, another has very recently been obtained by Friedel, which corresponds to a well-known carbon hexachloride.

We next pass to a compound of silicon with hydrogen It may be prepared in a pure state by means of a rather complex reaction I shall have presently to refer to; but we can easily obtain the impure gas by Wöhler's method, in treating a compound of silicon and magnesium with hydrochloric acid. We thus obtain a colourless, spontaneously inflammable gas, which burns with a bright light on contact with the air. In its pure condition, siliciuretted hydrogen is not spontaneously combustible at ordinary pressure, but in a slightly rarefied atmosphere it easily in flames. The compositions of these silicon and carbon compounds are shown in this table:—

* Delivered before the Royal Institution, May 2, 1873.

SiO_2.	Oxides.	CO_2.
$SiCl_4$.	Chlorides.	CCl_4.
Si_2Cl_6.	,,	C_2Cl_6.
SiH_4.	Hydrides.	CH_4.

The siliciuretted hydrogen is evidently the chemical analogue of marsh-gas, the tetrahydride of carbon.

It is usual to regard marsh-gas as the typical carbon compound from which some alcoholic series may be supposed to spring, and, in fact, all the alcohols belonging to the group of which the well-known wood-spirit and spirit of wine are the chief members, are commonly regarded as derivatives of marsh-gas, in which a part, or all, the hydrogen has been replaced by one or more compound radicals, such as hydroxyl, methyl, ethyl, propyl, &c. In these cases, the carbon of the marsh-gas is the grouping element of the compound, or that constituent which serves to bind together the different materials of which the molecular edifice is constructed. In the same way, the silicon in siliciuretted hydrogen may be shown to be the nucleus round which can be grouped hydroxyl, methyl, ethyl, &c., so as to form the alcohols whose compositions I shall presently have to refer to. Several of the less complex terms are still wanting, but their existence is rendered highly probable by the occurrence of bodies bearing the same close relation to the unknown alcohol that marsh-gas bears to wood-spirit, or the acid of vinegar (acetic acid) to common spirit of wine. As we ascend in the series, however, we meet with the true alcohols, in which silicon takes the place of carbon as the grouping element.

It must be here admitted, however, that no well-defined alcohols have yet been discovered in which silicon acts in any other way than as the nucleus of the compound; carbon radicals in all these cases playing the subordinate parts. But we have every reason to expect that complex alcohols containing silicon only will yet be obtained as researches extend.

In 1857 Buff and Wöhler obtained a volatile fuming liquid on heating crystalline silicon nearly to redness in a current of dry hydrochloric acid gas. The precise nature of this liquid was unknown until 1871, when Friedel and Crafts published the results of their admirable researches upon Buff and Wöhler's liquid, and showed that it was a mixture of chloride of silicon with a new body, which proved to be the strict chemical analogue of our well-known chloroform, silicon replacing carbon.

$SiHCl_3$. Chloroform. $CHCl_3$.

This body is a colourless, mobile, and very volatile liquid boiling at 35° C. I have a quantity of it in this tube. One of its most remarkable properties is that of exploding with great facility when its vapour is mixed with air. I shall now show you the experiment. Ordinary chloride of silicon does not afford an explosive mixture when its vapour is mingled with air. [Experiments shown.]

When this remarkable body is made to unite with anhydrous alcohol, a colourless ethereal liquid is obtained on distillation, having an agreeable odour, and a boiling-point at 134° C. This body is strictly analogous in composition to a substance obtained by Williamson and Kay, by acting on ordinary chloroform with sodium alcohol.

These ethers may each be regarded as derived from a glycerine or triatomic alcohol, as shown below. Neither of these alcohols have as yet been isolated.

$$Si\left\{\begin{array}{l}H\\OC_2H_5\\OC_2H_5\\OC_2H_5\end{array}\right. \quad \text{Formic ethers (tribasic).} \quad C\left\{\begin{array}{l}H\\OC_2H_5\\OC_2H_5\\OC_2H_5\end{array}\right.$$

$$Si\left\{\begin{array}{l}H\\OH\\OH\\OH\end{array}\right. \quad \text{Glycerins.} \quad C\left\{\begin{array}{l}H\\OH\\OH\\OH\end{array}\right.$$

By the action of sodium on the silicon ether just referred to we can obtain siliciuretted hydrogen in a state of purity. This is the only known mode of obtaining the pure compound.

Returning to the silicon chloroform, about whose chemical nature we can now have little if any doubt, we next have to enquire in what direction, and how far, we can pursue the analogy between the great pain-killer, discovered almost simultaneously by Soubeiran and the illustrious chemist of Giessen, who has so recently passed away from amongst us, and the curious body that we can obtain indirectly from flint or other form of silica in the manner I have described.

Ordinary chloroform is well known to be closely allied to common wood-spirit, or methyl alcohol, in a way that will be evident on comparing the formulæ. In fact, chloroform is easily obtained by treating wood-spirit with bleaching-powder. We cannot in any simple way reverse this process and prepare wood-spirit from chloroform, but we can do something in this direction, for we are able by the action of caustic potash to obtain from chloroform formic acid, a body which is one of the most remarkable products of oxidation of wood-spirit. The relation of formic acid to the alcohol is shown in the table below; and it is there further pointed out that this formic acid should yield an anhydride—a body capable of producing the acid by union with the elements of water. This anhydride is not known, but the importance of suggesting its existence will appear in a moment.

$$Si\left\{\begin{array}{l}H\\H\\H\\OH\end{array}\right. \quad \text{Methyl alcohols.} \quad C\left\{\begin{array}{l}H\\H\\H\\OH\end{array}\right.$$

$$Si\left\{\begin{array}{l}H\\O\\OH\end{array}\right. \quad \text{Formic acids.} \quad C\left\{\begin{array}{l}H\\O\\OH\end{array}\right.$$

$$Si\left\{\begin{array}{l}H\\O\\O(SiOH)\end{array}\right. \quad \text{Anhydrides.} \quad C\left\{\begin{array}{l}H\\O\\O(COH)\end{array}\right.$$

Regarding silicon-chloroform from the same point of view, analogy would lead us to look for a simple silicon alcohol similar to wood-spirit or methyl alcohol; but we would not expect the silicon-chloroform easily to yield this alcohol directly, though we would be justified in hoping that an acid corresponding to formic acid might be obtained. As a matter of fact, no such alcohol has as yet been prepared even indirectly; but a corresponding acid is very readily produced, and more than this, for the anhydride at present wanting in the carbon series is found in that of silicon. If I pass the vapour of silicon-chloroform into water nearly ice-cold, a white solid body is obtained without any evolution of hydrogen, and an acid liquid produced. The white solid then collected, washed, and dried at a low temperature, forms a white inflammable powder, which was first described by Buff and Wöhler. Friedel and Ladenburg have shown that this remarkable body is the anhydride of the silico-formic acid. According to the results of my own investigations, the acid liquid to which I referred just now contains, in addition to hydrochloric acid, the true silico-formic acid—a body possessing nearly as energetic reducing properties as the corresponding acid derived from wood-spirit. I shall now demonstrate these facts. [The lecturer then exhibited the experiments referred to.]

It will naturally be asked whether the silicon chloroform is capable of acting as an anæsthetic like ordinary chloroform. But it is only necessary to bear in mind the fact that it is very easily decomposed by water into gelatinous matter, and highly corrosive hydrochloric acid, in order to understand that its inhalation would be attended by the speedy destruction of the lungs of any person persisting in the experiment.

Starting from silicon chloroform, then, we have been led, by analogical reasoning in the first instance, to infer the existence of a simple silicon alcohol precisely corresponding to wood-spirit. On testing this induction by experiment, we have obtained answers which are, so far as they go, altogether favourable to the view just stated.

In fact, the results are as satisfactory as they can be short of the discovery of the silico-methyl alcohol.

I shall now endeavour to strengthen this position by showing that the existence of three higher members of the alcoholic series has been rendered highly probable by the discovery of closely related bodies, though the alcohols themselves have not been isolated; and, finally, I shall show that the alcohols of still higher terms have actually been obtained.

In the course of their elaborate and able investigation of silicon compounds, Friedel and Crafts discovered that chloride of silicon easily acts upon common alcohol as I have already mentioned, producing a body which Friedel and Ladenburg have recently shown to be easily attacked by a mixture of sodium with a curious substance contained in this tube—zinc-ethyl. The product, when treated with caustic potash, yields a body which bears the same relation to silico-propyl alcohol that formic acid does to wood-spirit. This relationship is shown in the formulæ—

$$\mathrm{Si}\left\{\begin{array}{l}C_2H_5\\ H\\ H\\ OH\end{array}\right. \quad \text{Propyl alcohols.} \quad \mathrm{C}\left\{\begin{array}{l}C_2H_5\\ H\\ H\\ OH\end{array}\right.$$

$$\mathrm{Si}\left\{\begin{array}{l}C_2H_5\\ O\\ OH\end{array}\right. \quad \text{Propionic acids.} \quad \mathrm{C}\left\{\begin{array}{l}C_2H_5\\ O\\ OH\end{array}\right.$$

This silico-propionic acid is in this tube, and is a white combustible powder, like the silico-formic anhydride I have already shown to you. It is soluble in warm caustic potash, but not in caustic soda; by which character it can be distinguished from silica. It is only necessary to state that it can be obtained in aqueous solution, and in the pure state, by Professor Graham's valuable dialytic process.

In the amyl term, neither alcohol nor acid are yet known; but by the action of zinc-methyl on chloride of silicon we can obtain a light, colourless, and very volatile liquid, which is silicon-methide, a body that may, for reasons which will presently appear, be fairly considered to stand in the same relation to silico-amyl alcohol that marsh-gas does to wood-spirit. Thus—

$$\mathrm{Si}\left\{\begin{array}{l}C_4H_9\\ H\\ H\\ H\end{array}\right. \quad \text{Amyl hydrides.} \quad \mathrm{C}\left\{\begin{array}{l}C_4H_9\\ H\\ H\\ H\end{array}\right.$$

$$\mathrm{Si}\left\{\begin{array}{l}C_4H_9\\ H\\ H\\ OH\end{array}\right. \quad \text{Alcohols.} \quad \mathrm{C}\left\{\begin{array}{l}C_4H_9\\ H\\ H\\ OH\end{array}\right.$$

The researches of Friedel and Crafts have made us acquainted with a body which may also probably be regarded as the hydride corresponding to silico-hexyl alcohol. This compound is prepared by the action of zinc-methide and zinc-ethide in chloride of silicon.

$$\mathrm{Si}\left\{\begin{array}{l}C_5H_{11}\\ H\\ H\\ H\end{array}\right. \quad \text{Hexyl hydrides.} \quad \mathrm{C}\left\{\begin{array}{l}C_5H_{11}\\ H\\ H\\ H\end{array}\right.$$

$$\mathrm{Si}\left\{\begin{array}{l}C_5H_{11}\\ H\\ H\\ OH\end{array}\right. \quad \text{Hexyl alcohols.} \quad \mathrm{C}\left\{\begin{array}{l}C_5H_{11}\\ H\\ H\\ OH\end{array}\right.$$

Having, therefore, grounds for inferring the existence of silico-propyl, silico-amyl, and silico-hexyl alcohols, I shall now pass at once to the second class of evidence, and show that the alcohols of still higher terms can actually be prepared.

In referring to the preparation of silico-propionic acid, it was stated that when chloride of silicon acts upon absolute alcohol a body is obtained which, on treatment with zinc-ethyl and sodium, yields an ethereal product from which silico-propionic acid can be obtained by treatment with caustic potash. If, however, instead of using the caustic alkali we continue the action of zinc-ethyl and sodium, decompose the products with water in sealed tubes, and distil, a liquid is obtained which contains one of the "alcohols from flint" we are in search of. In this tube I have a small quantity of the alcohol, and here you will find its composition stated—

$$\mathrm{Si}\left\{\begin{array}{l}C_2H_5\\ C_2H_5\\ C_2H_5\\ OH\end{array}\right. \quad \text{Heptyl alcohols.} \quad \mathrm{C}\left\{\begin{array}{l}C_2H_5\\ C_2H_5\\ C_2H_5\\ OH\end{array}\right.$$

You will observe that it is the silico-heptyl alcohol precisely corresponding to a simple carbon alcohol recently discovered by Nahapetian, both being *tertiary* alcohols. We owe to Ladenburg the discovery of this lowest known term of alcohols containing silicon. As you can observe it is a colourless liquid, not unlike the ordinary alcohol of wine. It is insoluble in water, but easily dissolved by spirit and ether. Chemically it acts just like any of the other alcohols, producing ethers, and dissolving the alkali metals to form sodium or potassium alcoholates. When common spirit burns you are aware that its flame is nearly colourless, but I shall now burn some of our alcohol from flint, and you will find, particularly when we feed the flame with oxygen, that a bright light is emitted.

Clearly defined though this alcohol is, it does not stand alone, for at least one other compound of the same order is known. It was suggested in 1870, by Friedel and Crafts, that silicon ethide—a body easily prepared by the action of chloride of silicon on zinc ethide—might be regarded as the hydride of silico-nonyl, and should stand in the same relation to an alcohol that marsh-gas does to common wood-spirit, or ethyl hydride to ordinary alcohol. This happy idea, when put to the test of experiment, was fully justified by the result, for, on treating silicon ethide in essentially the same manner that we should adopt in preparing wood-spirit from marsh-gas, a colourless liquid, lighter than, and insoluble in, water is obtained. The boiling-point of this body is 190° C. It yields an ether with acetic acid, dissolves sodium, forming an alcoholate, and, in fact, conforms to the general habits of the alcohols of the series to which common spirit belongs. The compositions of these bodies are thus represented—

$$\mathrm{Si}\left\{\begin{array}{l}C_8H_{17}\\ H\\ H\\ H\end{array}\right. \quad \text{Nonyl hydrides.} \quad \mathrm{C}\left\{\begin{array}{l}C_8H_{17}\\ H\\ H\\ H\end{array}\right.$$

$$\mathrm{Si}\left\{\begin{array}{l}C_8H_{17}\\ H\\ H\\ OH\end{array}\right. \quad \text{Alcohols.} \quad \mathrm{C}\left\{\begin{array}{l}C_8H_{17}\\ H\\ H\\ OH\end{array}\right.$$

It is thus shown to be precisely similar to the nonyl alcohol prepared by Pelouze and Cahours from American petroleum.

Ladenburg has very recently advanced even beyond the point we have now reached, and has shown that the chloride of silicon can be made to yield two ethers, which correspond, as I may suggest, to silico-nonyl diatomic and triatomic alcohols. Thus—

$$\mathrm{Si}\left\{\begin{array}{l}C_2H_5\\ C_2H_5\\ OC_2H_5\\ OC_2H_5\end{array}\right. \quad \text{or} \quad \mathrm{Si}\left\{\begin{array}{l}C_8H_{17}\\ H\\ OH\\ OH\end{array}\right.$$

$$\mathrm{Si}\left\{\begin{array}{l}C_2H_5\\ OC_2H_5\\ OC_2H_5\\ OC_2H_5\end{array}\right. \quad \text{or} \quad \mathrm{Si}\left\{\begin{array}{l}C_8H_{17}\\ OH\\ OH\\ OH\end{array}\right.$$

In all the preceding compounds it will have been noted that but one atom of silicon is present, and though, as I pointed out in the earlier part of this lecture, the silicon in these cases occupies the chief position as the grouping element, we should much like to see silicon uniting with silicon, and forming a more condensed compound with hydrogen. Happily, however, very important evidence, even upon this point, is forthcoming, for Friedel and Ladenburg have discovered corresponding hexa-chloride,

iodide, and bromide of silicon, and treatment of the hexaiodide with zinc-ethyl enables us to obtain the ethide whose formula is given in this table—

Hydride.	Chloride.	Ethide.
$\begin{matrix}\mathrm{Si}\\ \mathrm{Si}\end{matrix}\left\{\begin{matrix}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right.$	$\begin{matrix}\mathrm{Si}\\ \mathrm{Si}\end{matrix}\left\{\begin{matrix}\mathrm{Cl}\\ \mathrm{Cl}\\ \mathrm{Cl}\\ \mathrm{Cl}\\ \mathrm{Cl}\\ \mathrm{Cl}\end{matrix}\right.$	$\begin{matrix}\mathrm{Si}\\ \mathrm{Si}\end{matrix}\left\{\begin{matrix}\mathrm{C_2H_5}\\ \mathrm{C_2H_5}\\ \mathrm{C_2H_5}\\ \mathrm{C_2H_5}\\ \mathrm{C_2H_5}\\ \mathrm{C_2H_5}\end{matrix}\right.$

It is not improbable that in the last-named compound we have the starting-point of a new series of still more complex bodies, analogous to derivatives of olefiant-gas rather than to those of marsh-gas.

I trust you will now admit that the case I proposed to lay before you has been made out—namely, that we can obtain some alcohols indirectly from flint or other form of silica, and that we have solid ground for inferring the existence of many others.

A rich and beautiful field for chemical research appears to lie before us in tracing out the analogies between the compounds of carbon and silicon, and recognising the chemical representatives of many of the most complex "organic compounds" in the native silicates which form so large a part of the crust of this earth.

Hitherto in this lecture I have avoided reference to subjects not directly connected with the matter in hand, but, before concluding, I would refer, necessarily in a very few words, to some enquiries in this department of chemistry which have been carried on in the laboratory of the Royal Dublin Society. First, however, allow me to perform an experiment. I have here a glass jar filled with dry ammoniacal gas; when I drop into it some chloride of silicon, a white compound is obtained. This body was discovered by Persoz in 1830, and the composition he assigns to it would, as ably suggested by Dr. Hofmann, represent a mixture of sal-ammoniac with the hydrochlorate of silicon-guanidine. If this white body be ignited strongly in a closed vessel, an infusible white substance remains, which has been examined by Deville and Wöhler, who have shown that it contains silicon and nitrogen, and that the same or similar body can be produced by intensely heating crystalline silicon in an atmosphere of nitrogen.

My examination of this curious body has led me to the conclusion that it is the silicon analogue of cyanogen—a well-known compound of nitrogen with carbon, and the chief constituent of the deadly poison prussic acid. This body, though little affected even at a very high temperature, in the absence of moisture is easily decomposed by steam—silica, ammonia, and hydrogen resulting. A similar decomposition is effected by heating with soda-lime. I may add that, when this singular compound is fused with a small quantity of carbonate of potassium, cyanide and silicate of the metal are produced; in this case, carbon appears to displace silicon.

If, in the experiments with ammoniacal gas, we substitute silicon-chloroform for the silicic chloride, a body is obtained from which this compound of silicon and nitrogen can be easily extracted. Now we know well that when ordinary chloroform is heated with ammonia gas, chloride and cyanide of ammonium are obtained, and that under certain circumstances a body called *para-cyanogen* is also produced. Analogy would lead us to anticipate that silicon-chloroform would react in a similar manner, and the facts I have hitherto observed justify this inference.

It would be out of place to pursue this subject here, as the results of the enquiry referred to have not yet been published. I have, therefore, now simply shown to you one of the chief bodies to which interest belongs, and ventured to point out the relationship I believe it to bear to some of the well-known and remarkable compounds of carbon with nitrogen.

In concluding this lecture, I need simply remind the audience I have the honour to address that the practical value of scientific research is rarely apparent at first. Who could have suspected that the benzole discovered by the venerable philosopher whose name is so inseparably connected with this Institution, would have proved, in the able hands of Perkin and of Hofmann, the chief source of many of the exquisite dyes now largely manufactured in this country? Yet in this, as in a hundred of other instances, the small and apparently useless scientific seedling has gradually expanded into the strong tree, yielding its rich store of useful fruit. Let us hope that a similar future awaits some of the alcohols from flint which have been referred to this evening, and that, in pursuing our studies of the silicon analogues of the more complex carbon compounds, we may be led to appreciate more fully than we have hitherto done the admirable economy and harmony of Nature.

UTILISATION OF SEWAGE.*

The author of this pamphlet was commissioned by the Prussian Minister of Agriculture to pay an official visit to England, in order to inspect and report on the various systems of dealing with sewage. The result of his investigations may be fairly considered as one of the most instructive works ever written on this important question. Looking at facts with the eye of an unprejudiced observer, he tells us truths which may be unpalatable to certain enthusiasts.

In speaking of the Lodge Irrigation Farm, near Barking, he shows that the apparent profit of £1324 is in reality a loss of £157! "As far as I have observed," says the author, "almost all calculations upon the profits of sewage-irrigation farms in England have been drawn up in the same manner. Mr. Samuelson, M.P. for Banbury, with whom I had a very detailed conversation on the sewage question, informed me that he did not believe in the profitable working of a single sewage farm in England, notwithstanding all calculations as to apparent gain." He also quotes the following significant passage from the Birmingham report:—"It would be utterly irrational to expect anything but loss, even though the sewage itself may possess considerable manurial value."

In Banbury, again, M. Lefeldt finds an imaginary gain of £59 12s. 10d., which on close examination turns out to be a loss of £466, without any charge for the sewage.

The account of the Edinburgh irrigation meadows contains a most important fact: if the sewage-water is allowed to flow upon the land until two days before mowing, the growth is found most luxuriant, with the single drawback that cattle refuse to eat the grass. "The capillary tubes for some inches above the roots are found to be filled with unassimilated fœcal matters." Is it not, then, perfectly possible that the vegetables from irrigation farms may be contaminated in like manner? Man, at least in a state of civilisation, does not possess the instincts which warn cattle against such dangerous food. Is it prudent to uphold a system of agriculture which may thus introduce the germs of zymotic disease and the ova of entozoa into the human frame? "The city," says the author, "derives no pecuniary advantage from irrigation, and the authorities, as far back as 1839, proposed the abolition of the system, as the emanations from the land were by some persons considered unwholesome."

At Carlisle, where the sewage is disinfected with carbolic acid previous to being used for irrigation, the author met with no complaints of offensive effluvia, and hence he recommends some such previous treatment as very desirable.

Concerning the emanations of irrigation farms where no previous treatment is applied to the sewage, we find it

* "Der Gegenwaertige Stand der Abfuhr und Kanalisationsfrage in Grossbritannien. Berichte au Se. Excellenz, den Kgl. Preuss. Minister fuer die Landwithschaftlichen Angelegenteiten Erstattet," von W. Lefeldt, Civil Ingenieur in Schœningen. Berlin: Wiegandt and Hempel. 1872.

recorded that—"The landlord of the Peto Arms, near Barking Station, Mr. Jesse Bailey, declared that at times, especially on warm summer days when the wind blew direct from the Lodge Farm, the fumes were very unpleasant, although the distance is nearly a mile." Again—"The deposits of the notorious settling-tanks, and their entire vicinity, diffused truly *mephitic* odours. Even on the celebrated Breton Farm (Mr. Hope's) I experienced this, on my second visit, in the most horrible sense of the word."

The author considers that, where irrigation is adopted, an acre of land should be arranged to receive the secretions of every twenty to thirty-five persons. On this scale Birmingham would require a sewage farm of from 10,000 (Mr. Hope's estimate) to 13,000 acres, whilst London would require a snug little plot of some 150,000 to 200,000 acres. Well may M. Lefeldt exclaim—"That for large cities a vast tract of land, and a gigantic capital for purchase, preparation, and management, would be requisite, is so self-evident as scarcely to require mention." He adds—"The difficulty of irrigation lies here, that the purification and the economical application of the sewage must go hand in hand. Purification *alone*, with a total disregard of expense, is quite practicable; economic utilisation alone is also attainable in favourable cases. But the irrigation farmer is compelled to take and to purify the sewage when he can make no use of it—in rainy weather and in winter."

Such is the light in which sewage appears in the eyes of a disinterested and intelligent stranger. Surely we ought to pause before giving so unsatisfactory a system legal sanction.

ON THE

SPECTRA OF SOME COBALT COMPOUNDS IN BLOWPIPE CHEMISTRY.

By CHARLES HORNER.

It is well known that certain substances may be identified by the different colours they exhibit after the application of cobalt solution, or cobalt oxide, with the aid of heat; and having lately studied many of these compounds by means of the micro-spectroscope, I find the spectra vary sufficiently, in a few instances, affording not only additional evidence of the substance under examination, but also enabling us to form an opinion, in some cases, quantitatively.

In reference to the spectroscope, I may say that one of *low* dispersive power is essential for seeing distinctly the bands due to these compounds; and since the accurate position of the absorption bands had to be determined, I had recourse to the micro-spectroscope, which enabled me to measure them with precision, although a small hand spectroscope, like Mr. Browning's "Miniature" instrument, is very convenient, especially for examining the spectra of hot beads. Mr. Sorby's interference-plate was used as a scale of reference, whilst Mr. Browning's bright point micrometer served as an indicator.

Since Capt. Ross has lately proposed boric acid as a valuable flux for estimating the alkalies quantitatively, when combined with cobalt, and since my own experiments lead me to confirm some of his conclusions, I shall therefore begin at once with an account of these results.

When cobalt oxide is added to boric acid, and strongly fused for two or three minutes in the inner flame, using gas as a source of heat, the cold bead possesses a dull blue colour, and is almost opaque. However, by using a powerful light we can see it gives a spectrum of three very faint bands, nearly in the same position as shown in Fig. 2; if, now, 1 per cent of sodium carbonate be taken up, and the bead treated as before, when cold, the colour is a murky reddish-purple, and the spectrum no longer giving the band in the red, but two obscure absorption bands, very close together, and a slight shading at F, as shown in Fig. 1. Upon adding 4 per cent of soda the bead becomes quite clear and paler, showing the same spectrum, but while *hot* showing the band α, as in Fig. 2. A further addition of 10 per cent of sodium carbonate causes the bead to remain a dark purple when *cold*, and exhibiting the complete spectrum of Fig. 2. When 25 per cent has been added a blue bead results, and the spectrum in Fig. 2 changes; the band marked β is perceptibly lowered, overlapping D, as in Fig. 3, but the band γ *remains* as in Fig. 2. If 5 per cent more is taken up, the three absorption bands are like those drawn in Fig. 3, which represents cobalt dissolved in borax. The bead is now

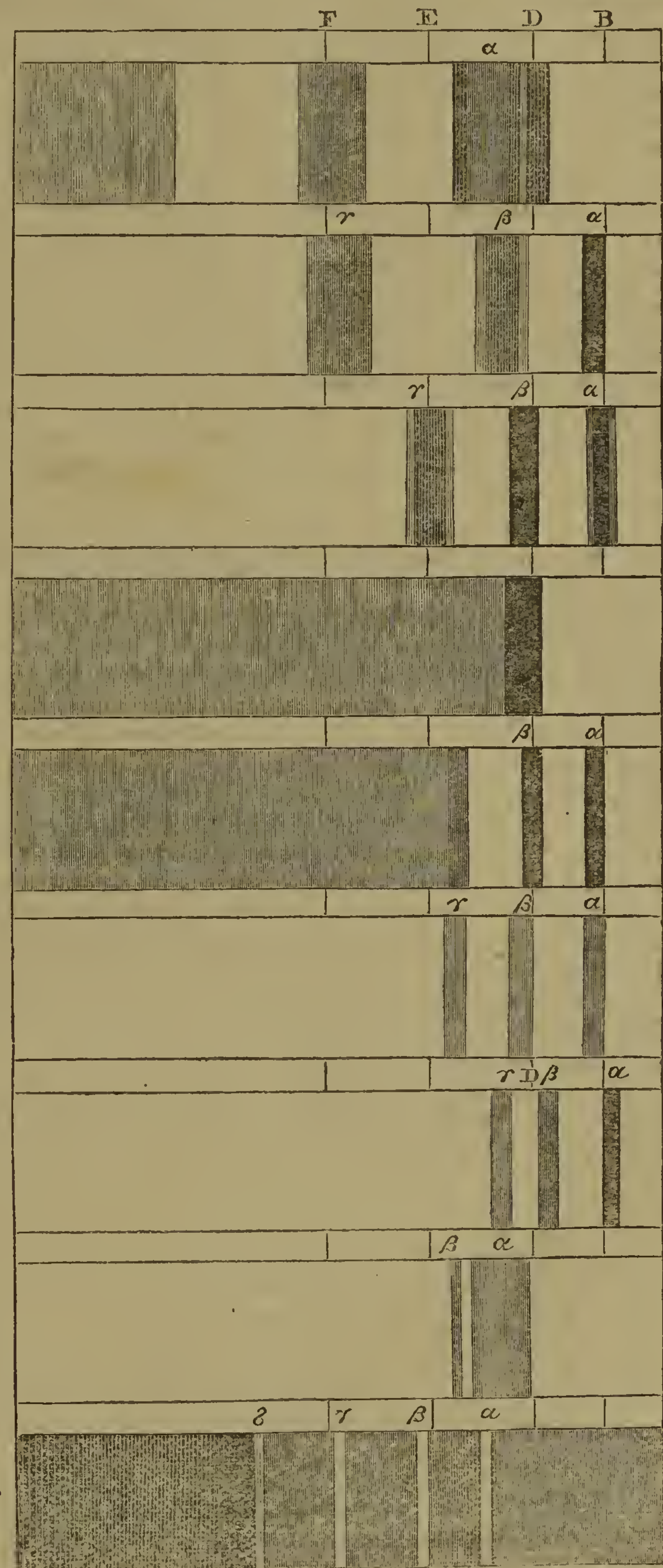

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

very dark, and requires pressing, whilst hot, between the points of the forceps, to render it sufficiently diaphanous. In these experiments it is necessary the amount of cobalt should be known when added to the weighed boric acid bead, since the determination of the alkali is affected by the quantity of oxide present; *e.g.*, if enough cobalt has not been dissolved, it may require $17\frac{1}{2}$ per cent of sodium carbonate to render the band visible in the red of Fig. 2.

I have not hitherto tried potash or lithia by the same method, but probably they would furnish equally interesting results.

Fig. 4 represents the spectrum of a salt of magnesia when moistened with solution of cobalt. It is a single band, with a good deal of shading in the green and blue.

Fig. 5 is the spectrum of the indigo-blue compound of calcium oxide when treated with cobalt. The application of the blowpipe flame is not requisite to fulfil this reaction, the colour appearing the same instant the solution is applied. Its spectrum shows the two bands very distinctly, especially the one in the red, and there is some shading in the green.

Fig. 6 is the interesting spectrum of the bright blue compound of alumina. These three bands, although generally faint, are narrow and well defined, the blue and green spaces being invariably clear. Websterite and cryolite show this spectrum to great advantage. With regard to silica, I have not, as yet, been able to form a compound giving a characteristic spectrum to be available as a means of detection in small quantities. Pure silica, as pointed out by Capt. Ross, turns purple when acted on by cobalt. This gives a spectrum very similar to the alumina compound, except in regard to the band in the green, which is not nearly so well defined. But in mixtures, as in minerals, this reaction is of no use. Sodium carbonate dissolves silica until there results a clear bead; when cobalt is added it assumes a deep indigo, and gives a spectrum of three sharply-defined dark bands, somewhat resembling those in the borax compound, only the band in the green being more refrangible, and therefore the most characteristic. The beautiful green compound of oxide of zinc which is occasionally used as a pigment, and known as Rinman's green, gives the spectrum pourtrayed in Fig. 7.

The last compound to which I shall now draw attention is sodium carbonate and boric acid. When a thin soda bead is formed with a mere fragment of boric acid, and fused along with a little cobalt, in the outer flame, the bead while hot is of a deep orange-brown colour, turning nearly black and opaque on cooling, but before becoming quite cold rapidly crystallises and turns green. By transmitted light the whole of the blue is cut off and part of the red, while a narrow band is visible at the yellow end of the green. If the bead, however, be submitted to the action of the inner flame, it turns a pale blue while hot, and crystallises on cooling to a pale pink by transmitted light, and assuming a lavender tint by reflected light. This unique spectrum of the pink bead is depicted in Fig. 8; and fig. 9 represents the flame spectrum of boric acid, consisting of four bright bands.

The following are the numerical values of the several absorption bands, according to Mr. Sorby's ingenious method of notation (*Proc. R. S.*, vol. xv., p. 434):—

Fig. 1	.. ..	$\alpha=\ddot{4}\frac{1}{2}, \beta=\dot{3}\frac{3}{8}$
Fig. 2	.. ..	$\alpha=\dot{2}, \beta=\dot{4}\frac{1}{2}$
Fig. 3	.. ..	$\alpha=\bar{1}\frac{5}{8}, \beta=\bar{3}\frac{5}{8}, \gamma=\ddot{5}\frac{3}{4}$
Fig. 4	.. ..	$\alpha=\ddot{3}\frac{1}{2}$
Fig. 5	.. ..	$\alpha=\bar{2}, \beta=\ddot{3}\frac{1}{2}, \dot{4}\frac{1}{4}\ldots\ldots$
Fig. 6	.. ..	$\alpha=\dot{2}, \beta=\dot{3}\frac{3}{4}, \gamma=\dot{5}\frac{3}{4}$
Fig. 7	.. ..	$\alpha=\bar{1}\frac{1}{2}, \beta=\dot{3}, \gamma=\dot{4}\frac{1}{2}$
Fig. 8	.. ..	$\alpha=\ddot{4}\frac{1}{4}, \beta=\ddot{5}\frac{3}{8}$

Fig. 9 measured by the bright point micrometer Na = 1·64°

$\alpha=2{\cdot}25°, \beta=2{\cdot}80°, \gamma=3{\cdot}35°, \delta=3{\cdot}89°.$

OBITUARY.

JAMES WALLACE YOUNG.

James Wallace Young, aged 30, died at Portobello, on the 12th inst. He was an ardent student of Chemistry of great promise, and was a not infrequent contributor to these pages. His researches were mostly in the field of Chemical Geology, and his papers were always marked by close reasoning and his analyses by minute accuracy. Of a disposition the most kindly and modest, his only earthly ambition was to be a good chemist and microscopist. How far he succeeded in both of these objects is shown by many careful analyses published in these pages, while his enthusiasm as a microscopist is shown in the fine collection of rock sections which he had for years been engaged preparing during his spare hours.

CORRESPONDENCE.

DETERMINING FAT IN MILK.

To the Editor of the Chemical News.

Sir,—In a letter which I wrote to you by last mail, I mentioned the difficulty I had lately met with in determining the weight of the fat in milk. A borate mis-called ether, but consisting really of a mixture of water, alcohol, and ether, was the cause of the failure. I had every reason to suppose the ether good, and in a cold climate the defect would at once have proclaimed itself, but, working as I am at 90° to 92° F., a very little ether suffices to give a strong ethereal smell to a very poor mixture.

Below I send you a description of the method I have lately used for the estimation of fat in milk. I dont know if it is a new one, anyhow I find it a very ready and successful one.—I am, &c.,

F. N. Macnamara.

Medical College, Calcutta,
April 4, 1873.

Take a tube of about 50 c.c. capacity, and, having drawn out one end, introduce 10 c.c. of milk and an equal quantity of alcohol and of ether. Seal the tube, and keep it for two hours in a water-bath at a temperature of 180° F. Allow the tube to cool; break off one end, and allow the fluid part of the contents to drain into a small flask. Exhaust the remaining contents of the tube into boiling ether, and add the washings to the contents of the flask. Let the contents of the flask evaporate till about 10 c.c. of fluid remain; then, when the flask is cool, add ether, and separate, by means of a separating tube, the ethereal solution of fat from the watery fluid. Let the ethereal solution evaporate to dryness in a very small weighed beaker, heat to 212° in a water oven for two hours, and, when cool, weigh. Finally, test the residue as to its solubility in ether before calculating out the result.—F. N. M.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 28, 1873.

Manufacture of Sulphate of Ammonia from Nitrogenous Refuse.—L. L'Hote.—The refuse is treated with a dilute solution of caustic soda, either in the cold or at a very gentle heat. A solution or disagregation of the matter is thus obtained. The viscid liquid thus obtained is made into a paste with slaked lime, and the mass is then introduced into a cast-iron retort communicating with receivers containing chamber acid. It is distilled at

the lowest possible temperature to avoid decomposition of the ammonia. When all liberation of gas has ceased the retort is raised to redness. When the operation is complete, a white powder remains in the retort, composed exclusively (?) of carbonate of soda and quick-lime, which, on treatment with water, reproduces caustic soda to serve for a new operation. The sulphate of ammonia thus obtained is coloured, but may be purified by re-crystallisation. If care is taken to operate on a homogeneous mixture of refuse and of alkalies, the whole of the organic nitrogen is recovered as ammonia.

Conditions under which Super-Silicated Cast-Metal is Produced in Blast-Furnaces.— Samson Jordan.—Managers of blast-furnaces, especially such as have had to produce cast-metal destined for the Bessemer process, have been called on to study the conditions under which the so-called "hot" cast-iron is produced, containing silicon to the extent of $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent. Some have even manufactured extra silicated cast-iron containing 7 to 8 per cent. These latter pigs have a quite peculiar aspect. The colour of the recent fracture grows lighter as the proportion of silicon augments; the grain becomes larger, but flat, slightly rounded, without any projecting points or ridges. Its lustre recalls that of pure silicon. The finger in passing over the fracture experiences a sensation quite different from the touch peculiar to pigs rich in graphitic carbon. Thus, in the works which produce these extra silicated cast-irons, they are known under the name of "glazed pig." The following is the analysis of pig-iron of this nature manufactured at Towlaw, near Newcastle:—

Carbon	2·39
Silicon	5·73
Sulphur	0·12
Phosphorus	0·13
Titanium	0·02
Nickel and cobalt	0·04
Manganese	1·33
Iron	90·21
	99·97

The author has studied the production of extra silicated pig-iron at the works at Heerdt, near Dusseldorf. In consequence of an accident to the tubes, which led the air to six tuyeres of the furnace, it was necessary to work during eight days, blowing only through three with a feeble pressure. The temperature of the blast was extremely high, and the charge of minerals was much diminished. The fusible matters in this charge, and which were to form the slag, were in the following proportions:—

Silica	50	Oxygen	26·0
Alumina	16		
Lime	33	Oxygen	17·6
Protoxide of manganese	1		

Proportion of the oxygen of the silica to that of the bases—

$$\frac{26\cdot0}{17\cdot6}$$

With this charge a viscid slag was obtained, which when once cooled was, like all slags rich in alumina, vitreous and translucid; its colour was an opalescent whitish blue. The melted iron was very liquid, and excessively hot: it flowed in the channel of sand with a homogeneous appearance, without the least bubbling up and without sparks, like melted lead. It filled the moulds exactly without adhering to the sand. When cold it was very brittle, and less sonorous than usual. Its analysis showed:—

Silicon	7·90
Phosphorus	0·72
Carbon	2·60

This is a characteristic "glazed pig-iron." The consumption of coke was 2100 kilos. to 1000 kilos. of metal. In works which employ aluminous minerals, like those of Aveyron which use that of Mondalagac, containing—

Alumina	11·5
Silica	10·0
Lime and magnesia	15·0

highly silicated pigs are ordinarily produced, which waste much in puddling. This production of pig-iron with an aluminous charge is always accompanied with a high consumption of coke. At the St. Louis works near Marseilles, which commonly yield pure grey pig-irons with slags containing—

Silica	33·0
Alumina	15·0
Lime	50·0
Magnesia, manganese, &c.	2·0

the pigs generally contain not more than 1 to 1·5 of silicon. To obtain extra hot Bessemer pigs containing 4 per cent of silicon the charge is modified so as to have—

Silica	40·0
Alumina	19·0
Lime and magnesia	41·0

The conditions for obtaining extra silicated pig-metal are slow working at very high temperature and siliceous, and at the same time highly aluminous, charges. Great heat is required for the alloy of silicon and iron produced, which is more infusible than the common carboniferous cast-iron. The operation must be slow in order that the reduction of silica in presence of carbon and iron may be extensively effected. The proportion of lime must be reduced lest its affinity for silica might interfere with the reduction of the latter, and the alumina is increased to neutralise further the basic action of the lime.

Memoirs on the Actions Produced by Molecular Attraction in Capillary Spaces.—M. Becquerel.—The conclusions arrived at in this memoir are these:—1. Liquid layers adherent in capillary spaces, besides being capable of conducting electricity, have other properties which should be considered in studying electro-chemical phenomena. 2. When certain saturated non-metallic solutions are used, which produce double decompositions in their reciprocal reaction without capillary spaces with formation of insoluble precipitate, this precipitate is not formed in the interior of a capillary space where the walls are of glass (as in a cracked tube); there is a contest between the capillary affinities and the affinities between the two liquids which meet, and the latter are overcome. 3. Finely divided portions of matter, which is insoluble but constantly moist, behave like solid conducting substances on contact with an oxidisable metal, a number of electro-capillary currents are produced, which act like the ordinary voltaic currents. 4. Simple electro-capillary currents might, on account of their small intensity, be used as units for comparing electromotive forces in general; but such couples, when there is no metallic reduction, not being of constant current, this application is limited. 5. One may have an idea of the difference which exists between the capillary affinities exercised by the walls on each of the two solutions, and the affinities uniting their constituent parts, from examining on which side precipitates are formed, within or without the crack. If within, this shows that the capillary affinity is less for the exterior than for the interior liquid.

Heat Liberated in Reaction Between Alkalies and Water, Potash and Soda.—M. Berthelot.—A thermo-chemical study which scarcely permits of being summarised.

Combinations Formed under the Influence of the Solvent Electric Discharge (Effluve) by Marsh-Gas and Carbonic Acid on the One Hand, and by Carbonic Oxide and Hydrogen on the Other.—MM. P. and A. Thenard.—In opposition to Sir B. Brodie's results, as given in our issue of 18th ult., these observers state that they found in the cases of both mixtures the contraction *continuous*; and that the product was in the form of a *liquid* condensed on the sides of the tube in drops, at first colourless but later becoming amber coloured, and

passing from the oleaginous to the viscid state. Analysis gave somewhat negative results as to the chemical nature of the products in the two tubes (an aqueous solution had a strong smell of metaceton along with formic products; and the liquid in the second tube, treated with potash, alcohol, and ether, gave a precipitate resembling beer yeast, but which produced no fermentation); it was sufficienly evident, however, that very numerous and complex products are obtainable by this process. The authors add that the silent discharge is capable of dissolving certain organic bodies such as acetic acid; which, under its influence, gives carbonic oxide or marsh-gas, leaving a brown product soluble in potash. They are having new apparatus constructed specially for the above class of experiments.

Certain Spectroscopic Observations.—P. A. Secchi.—Referring to the dark line observed with the spectroscope, at the base of the chromosphere, and separating this from the edge of the solar disc, P. Secchi thinks it sufficiently explained by absorption in the chromosphere. Supposing the chromosphere 10 or 12 seconds high, certain rays from the deeper regions (he calculates) would have to traverse as much as 100,000 kilometres of its matter to reach the observer. He opposes the assertion that the chromosphere is wanting at the spots (M. Faye maintained on behalf of his theory that the hydrogen was in such a case "engulphed") stating that, in hundreds of observations, he found it absent only once, and then not near a spot. He supposes some unknown body to have intervened. The assertion referred to had arisen from observing that the weak light of hydrogen disappeared when the brighter light from a mixed layer of hydrogen and metals appeared in the field of the telescope. By narrowing the slit the bright line C would appear above these very bright masses. P. Secchi further gives an account, with sketches, of a remarkable ramified mass of hydrogen he observed on April 3, the upward velocity of which he estimates at 90·5 kilos. per second. It was quite isolated all the time. He is led to think the solar atmosphere must extend at least eight minutes; and he finds his observations justify Lord Linsay's photographs, and confirm M. Janssen's view as to the dynamic state of the solar atmosphere.

Application of the Pandynamometer to the Measurement of Work Done by a Steam-Engine, according to the Flexure of the Beam.—M. G. A. Hirn.

Extract from Memoir on the Application of the Mathematical Theory of Elasticity to the Study of Articulated Systems Formed of Elastic Rods.—M. Maurice Levy.

Examination of Differences Presented by the Spectrum of Chlorophyll according to the Nature of the Solvent.—M. Chautard.—The author operated with solutions of chlorophyll in alcohol, ether, chloroform, various essences and oils, sulphide of carbon, &c. Among the oils he distinguishes between those which are naturally quite inactive with the prism and those which, with sufficient thickness, produce an absorption of certain rays. Among the latter are the oils from olive, colza, flax, and laurel; and the bands produced are, according to the author, due to the presence of chlorophyll, whether in the fleshy envelope (as with olive) or in the cotyledons of the seed. All these fruits and seeds, treated directly with alcohol, give a liquor having spectral properties which correspond to those of the oil. An alcoholic solution of ripe olives gives a spectrum somewhat different from that obtained with the ripened fruit.

Vapours Emitted at the same Temperature by the same Body in Two Different States.—M. J. Moutier.—M. Moutier had formerly shown that such vapours had different tensions. Water at zero, *e.g.*, emits vapour, the tensions of which are unequal, according as the water is taken in the liquid or the solid state. He now finds these results confirmed, from a study of the specific heats of saturated vapours.

Emission Spectrum of Erbine.—M. Lecoq de Boisbaudran.—Erbine is one of the few solid substances which produce a discontinuous spectrum of bright lines. According to MM. Bunsen and Bahr, the addition of phosphoric acid simply intensified the bright lines, but the present observer finds that it produces a spectrum quite distinct from that of erbine alone.

Observations Relative to M. Du Moncel's Last Note on the History of the Silent Electric Discharge.—M. Arn. Thénard.—The writer claims the priority of having effected the dissociation of carbonic acid by this new agent.

Experiments on the Effects of Dynamite.—MM. Roux and Sarrau.—These experiments clear up some obscure points. Dynamite inflamed by violent percussion, as that produced by the detonation of a strong fulminating capsule, give an explosion even in free air, and, if confined, produces an effect such that 1 of nitro-glycerine corresponds to at least 10 of ordinary powder. Inflamed by any other means, without percussion, it is simply fused in free air, and, if confined, it may explode, but this explosion, whatever the temperature and pressure, is of an entirely different nature from that of the *first order*, or detonation. An explosion of the *second order* is such that 1 of nitro-glycerine corresponds to about 2 of powder. The experiments were chiefly made with metallic bombs. A dynamite is more powerful in proportion as it is more easily inflamed through percussion. Where not readily inflamed, only part of the mass detonates, the rest acting by simple explosion.

Bulletin de la Société Chimique de Paris, April 20, 1873.

At a meeting of the Society, held on March 21st, M. Grat West explained the object and principles of his work — "Statistique des Volumes des Equivalents Chimiques." He proposes to reconcile the present chemical theories, to admit the electric popularity of molecules. M. Jannetaz presented a copy of his thesis on the propagation of heat in crystalline bodies. He arrives at the general law, that in crystals the major axis of conductibility is parallel to the easiest cleavage.

Researches on the Double Decomposition of Saline Solutions.—L. Joulin.—This important paper will shortly appear at full length.

Decomposition of Metallic Carbonates of Heat.—L. Joulin. (See p. 211).

Crystalline Benzoic Acid obtained from Benzoin.—M. Guichard.—In order to study the solvent action of bisulphide of carbon upon certain pharmaceutical products, the author placed, on June 23rd, 1870, gum benzoin to macerate in this solvent. During the siege of Paris the bottle was placed in a shed, and exposed to all the variations of temperature through the winter. On his return the benzoin was found solidified in the upper part, and under it voluminous crystals were fixed like stalactites. The bisulphide almost entirely evaporated in the water-bath, deposited on cooling very brilliant macreous spangles grouped in stars, and tainted with a little resinous matter. These crystals, as well as the former, had all the properties of benzoic acid.

Heat Disengaged in the Reaction of Hydracids and Water, and on the Molecular Volume of Solutions.—M. Berthelot.—This paper also is reserved for insertion at length.

On Rosolic Acid.—MM. Prud'homme.—The procedure generally employed in the manufacture of this acid, commercially known as coralline, is heating for 5 to 6 hours to about 140° or 150° C. a mixture of 1 part oxalic acid, 1½ parts phenol, and 2 parts sulphuric acid. Fresenius ascribes the formation of rosolic acid to the action of nascent oxide of carbon upon sulphophenic acid. The author holds that the presence of a sulpho-conjugate acid is unnecessary, and that the sulphuric acid merely acts as a dehydrator. In fact, rosolic acid is formed if the sul-

phuric acid is replaced by the boracic, arsenious, or arsenic acid. The two former of these if heated alone with phenol do not yield a trace of colouring matter. Arsenic acid alone with phenol gives a colouring matter, which Fel has named xanthic acid, but which must not be confounded with rosolic acid. If phenol is heated with sublimed oxalic acid, free from water of crystallisation, rosolic acid is produced. Ordinary oxalic acid heated for several hours with phenol yields no rosolic acid. If, however, certain points of the flask in which the reaction takes place are superheated traces of colour are produced at these points, as the case of sublimed oxalic acid is thus reached. From these experiments it appears that the formation of rosolic acid is simply due to the direct action of the nascent carbonic oxide. Fresenius has shown, by direct experiments, that the carbonic acid arising from the oxalic acid is without influence. Kolbe has put forward the hypothesis that rosolic acid may be regarded as formylic phenol, according to the equation—$C_6H_5OH + CO = C_6H_4COHOH$. The hypothesis agree with the author's experimental results.

Characteristic Properties of the Common Oils.—M. G. Glœsner. (See p. 212).

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxx., No. 17, April 23, 1873.

Combustion of the Diamond.—An experiment lately made by Mr. Spence, of Manchester, seems to prove that under certain conditions the diamond is combustible at a much lower temperature than has been hitherto supposed. A South African diamond of the size of a small pea, coated with refractory clay, was placed in a crucible with a mixture of soda and hydrate of lime, and then heated in a muffle for three days and three nights. On opening the mass, it was found that the diamond had entirely disappeared, although the heat had never exceeded a cherry-red.

New Mode of Preparing Animal Manures.—Coignet proposes to treat animal refuse of all kinds with superheated steam to effect its conversion into manure without nuisance. He is convinced that this will be the best method of treating the offal of the slaughtered oxen on the La Plata.

Highly Soluble Collodion.—Adolphe Martin recommends the following form of gun-cotton for the preparation of collodion:—Take two parts of sulphuric acid at 66° Baumé, to which is added one part of dry nitrate of potash. When the mixture has reached the temperature of 55° C., cotton is put into it by small portions, taking care to immerse and saturate them as rapidly as possible. After steeping for seven or eight minutes, the whole is thrown at once into a large quantity of water, and washed rapidly till completely neutral. It is then carded with copper cards, to eliminate all pulverulent matters. 8 grs. of cotton are used to 300 grs. of the acid mixture.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 245, May, 1873.

Report of the Prizes Offered by the Society and Awarded in 1873.—*Chemical Arts.*—Six prizes have been offered: 1. Prize of 2000 frs. for the industrial application of distilled water; no candidate. 2. Prize of 1000 frs. for the industrial application of any cheap and abundant mineral product; no candidate. 3. Prize of 1000 frs. for a useful application of recently discovered metals; no candidate. 4. Prize of 3000 frs. for the artificial preparation of a black compact diamond; one candidate appeared, but, as the experiments of the Committee showed that the specimens sent did not fulfil the conditions required, the prize was not awarded. 5. Prize of 1000 frs. for a process capable of effecting the prompt and durable disinfection and clarification of sewage; the Engineers of the Municipal Service of Paris, commissioned to study the question of disinfection and the applications of sewage-water, have presented a complete and detailed account of the experiments made, and the remarkable results obtained; as these experiments have been conducted on a very small scale, and, as important sewage works are in progress, the Council of the Society has decided to suspend the award of the prize. 6. Prize of 1000 frs. for refining, in France, Bolivian nitrate of soda, and extracting the iodine which it contains. *Economic Arts.*—Prize of 3000 frs. for an apparatus giving an electric current constant in direction and intensity, whose electro-motive force and conductibility shall be comparable to those of a nitric acid battery of sixty to eighty ordinary sized elements, and showing superiority in economy or salubrity over the machines now in use; the prize was awarded to M. Gramme for his magneto-electric machine.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, November and December, 1872.

The Mines of the Island of Sardinia.—M. Sella.—From this long and elaborate report we extract the following:—The minerals constituting the metalliferous deposits of the island are very various. Those most generally met with are sulphide of lead, more or less argentiferous, sulphide of zinc (blende), sulphide of iron, or ordinary pyrites, as well as double sulphide of iron and copper. The sulphides of zinc and lead are often accompanied, at least in the upper part of the deposits, by oxidised minerals, such as carbonate of lead (cerussite), sulphate of lead (anglesite), and carbonate and silicate of zinc, which in Sardinia are both designated calamine. Less abundant are sulphide of antimony, sulph-arsenides and sulph-antimonides of copper, of cobalt and nickel, grey copper and nickel. Still more rare are silver and pyrargirite. The proportion of silver in the galenas is very variable. That found in the veins, properly so-called, is much more argentiferous than those of the beds, in accordance with the calcareous stratification in the district of Iglesias. In these latter deposits, the silver ranges from 12 to 25 grms. per quintal of ore, but occasionally it amounts to 35 to 50 grms. in the mixed beds of galena, carbonate of lead, and calamine. In the veins, properly so-called, the amount of silver is rarely below 30 to 35 grms., and varies generally from 50 to 120 grms. A part of the mine of Sangiorgio regularly yields 560 grms. per quintal of ore, or 900 per quintal of lead.

Essay on Blast-Furnaces.—L. Gruner.—This paper does not admit of abstraction, whilst its great length and speciality prevent its insertion *in extenso* in our columns.

The Oxyhydrogen Light.—Report of F. Le Blanc, Gas-Tester to the city of Paris.—The author considers it proved that the manufacture of oxygen on the large scale is quite practicable. The proportion of nitrogen present was not found less than from 13 to 14 per cent, and, from a variety of causes, a higher standard of purity can scarcely be expected. There has been no opportunity of verifying the inventor's statement concerning the length of time—a year at least—that the manganate of soda will serve without revivification. To keep the reagents in a serviceable state in the retorts, the air admitted must be previously deprived of its carbonic acid. His conclusion is that the Company Tessie du Motay has not been able to show any commercial economy, and that, for an equal amount of light, the system is more expensive than lighting with ordinary coal-gas. There may be certain special cases where this light, possibly too brilliant for ordinary use, will be advantageous. The hygienic employment of oxygen in hospitals is neither practically useful nor preferable to good ventilation. In certain cases, an excess of oxygen in the air might have an unfavourable influence. As regards heating and metallurgical operations, if we except the extraction and fusion of platinum by Ste.-Claire Deville's method, it is by no means demonstrated that this gas would be preferable to atmospheric air.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 16, February 20, 1873.

This number contains no chemical papers, either scientific or technological.

No. 17, February 27, 1873.

The only paper in this number touching upon chemistry or its allied sciences is an account of Gramme's new magneto-electric machine.

Revue Scientifique de la France et de l'Etranger, No. 43, April 26, 1873.

This number contains no chemical or physical papers.

Annales de Chimie et de Physique, April, 1873.

Memoir on the Elliptical Double Refraction of Quartz.—M. Marcel Croullebois.—The purpose of this memoir is (1) a direct demonstration of the existence of the two reciprocal elliptic rays, into which, according to Airy's hypothesis, natural or polarised light, incident on quartz in certain directions, is decomposed; (2) the laws governing this double elliptic refraction, or the transmission of rays through pieces of quartz differently combined, and of contrary rotations. After a mathematical study of the phenomenon, the author describes three bi-prisms he had constructed. The first, which he calls an *elliptic bi-refringent bi-prism*, has the form of a parallelopiped, composed of two prisms of quartz of contrary rotations, with the same refringent angle, and joined by their hypothenuse faces. The terminal faces are inclined at the same angle (80°) to the optic axes, and the two principal sections are at right angles. The instrument can be advantageously used in studying the various forms of polarisation, chromatic, plane, circular, and elliptical. In the second bi-prism, the terminal faces of the two quartz prisms are oblique to the axis, and their principal sections are parallel. The third bi-prism consists of two prisms of the same nature (lævogyrate), with the principal sections at right angles. Various experiments with these instruments are described.

Note on the Fusion of Platinum.—M. Henry Violette.—The writer made some experiments on the fusion of metals in a little draught-furnace (only 1 cubic metre in external volume) which he had constructed at the bottom of an ordinary brick chimney, 30 metres high, in a saltpetre refinery. He could thus obtain an intense heat, rapidly produced, which he thinks might be utilised by chemists in various ways.

Report to the Academy relative to the Observation of the Eclipse of December 12th, 1871, observed at Sholoor, Hindustan.—M. I. Janssen.—This detailed account is in four parts—the choice of instruments, the voyage, the observation, and discussion. The last refers mainly to the nature of the "coronal atmosphere."

Considerations on the Disaggregation of Rocks: Increase of Volume in Crystallisation.—M. Fred. Kuhlmann.—The author gives several examples of the fixation of water in crystallisation of salts at low temperature; the increase of volume having been found always proportionate to the quantity of water fixed. By such increase, M. Kuhlmann explains the swelling and distortion sometimes observed in building-plaster, the destruction of monuments, the disaggregation of pyrites exposed in moist air, and other phenomena. He considers the influence of crystallisable salts in saturated solutions might, in some cases, be substituted for the action of machines in division of rocks, especially felspar and the natural phosphates.

Heat of Solution of Salts.—M. J. Moutier.—Kirchhoff has shown that the thermic effect, when a solid or liquid substance is dissolved in water, is intimately connected with the tension of the vapour emitted by the solution; and he has given a formula which permits of calculating the heat absorbed or liberated by the solution, when one has a table of tensions of vapour furnished by the solution at different temperatures. The formula agrees with experiment in the case of mixtures of sulphuric acid and water, as seen from a comparison of Favre and Silbermann's experiments with those of Regnault. M. Moutier, in the present paper, compares theory with experiment in the case of solutions of salt in water, taking Wüllner's experiments on the vapour-tensions of various solutions, along with those of Persoz as to the heat absorbed by the solutions in similar circumstances. Of the solutions examined by Wüllner, marine salt, sulphate of soda, nitrate of soda, chloride of potassium, sulphate of potash, nitrate of potash, M. Moutier takes the last, by preference, and finds in it a new verification of Kirchhoff's theory.

Review of Foreign Work on Physics.—M. Bertin.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Delivered from October 12 to October 18, 1872.

An improvement in the manufacture of soap. Nicholas Bickford, chemist, Exmouth, Devon. October 14, 1872.—No. 3017. This invention consists in adding to soap, made in the usual way by alkalies, a very finely levigated powder or a solution of French chalk *(cretá gallica)*.

Improvements in apparatus for the treatment of sewage. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. October 14, 1872.—No. 3028. The first part of the invention (having reference to the clarification of sewage only) relates to the method of supplying the lime to the sewage for the purpose of precipitation by the lime process, the main object being to economise labour, and effect the purpose by mechanical means. The second part of the invention consists in treating the sludge after its separation from the sewage-water, whether by straining, subsidence, or precipitation, by a process in which a stirring movement or agitating of the particles is combined with pressure and filtration.

Improvements in treating sulphides, and in obtaining products therefrom. James Hargreaves, chemist, and Thomas Robinson, iron-founder, Widnes, Lancaster. October 15, 1872.—No. 3032. Sulphides of iron and manganese, or either of them, produced by deoxidising a mixture of oxides of these metals, or either of them, with sulphates of soda and potash, or either of them, are reacted upon by hydrochloric acid either in the gaseous state or in solution in suitable chambers or vessels, and chloride of iron and manganese, or either of them, thereby produced. When in the production of chlorides as above it is desired to produce sulphide of hydrogen we add the hydrochloric acid to non-oxidised sulphides of iron and manganese, or either of them. When we wish to obtain sulphur we take sulphides of iron and manganese, or either of them, after they have been exposed to the air so as to become oxidised.

Improvements in apparatus employed in the manufacture of sulphates of soda and potassa. James Hargreaves, chemist, and Thomas Robinson, iron-founder, Widnes, Lancaster. October 16, 1872.—No. 3052. Our invention relates to improvements in, upon, and connected with the manufacture of sulphate of soda and sulphate of potassa, or either of them, by our direct action process, that is to say, by reacting directly upon chloride of sodium and chloride of potassium, or either of them, with sulphurous acid or its equivalent. First. To facilitate conversion of salt into sulphate, and to secure means whereby discharge can be effected rapidly, we dispose the chambers in a long single line, and construct each chamber with two doors, preferably opposite each other. Second. To facilitate the discharging of sulphate from converting chambers, we dispose the chambers in any convenient position, and construct them each with two or more doors, preferably on opposite sides, so as to be able to employ two gangs of men. Third. To provide means whereby the contents of a chamber can be more easily withdrawn than when the present grids are employed, we rest the carrying bars or supporters on movable pillars; upon withdrawal of these movable pillars the carrying bar or supporters are allowed to fall; the contents are thereby easily reached. Fourth. To construct manufacturing plant economically, and to provide means whereby such plant can be extended at small cost, and also repaired without disturbing general working, we place the series of converting chambers in a line, and dispose the sulphurous acid and gas flue along one side of the line, and the circulating gas flue along the opposite side. The said circulating gas and sulphurous acid flues are provided with lute holes opposite each chamber to receive the ends of movable syphons. Corresponding holes for the other ends of the syphons are formed in the tops of the chambers. Fifth. To provide proper flue space over each converting chamber by durable appliances capable of preventing radiation of heat, we employ instead of a brick arch a metal covering plate or piece; this is made to rest or be supported over the top of the chamber, and salt is placed thereon. In practice we prefer that the distance between the top of the cylinder and the covering plate should be about ten inches. The said plate or piece has, as will

be obvious, holes to receive the salt feed pipes. Sixth. To provide means for cooling the converting chamber, when such becomes necessary from carelessness on the part of workmen or from excessive development of heat during reaction, we construct air passages leading from the atmosphere into the space between the covering plate and the cylinder cover that the air may circulate over the top and downwards around the chamber. Seventh. As means for constructing large converting iron chambers economically, and also for facilitating transport, we construct them each in segments so formed with corresponding edges that they dovetail or hook one into the other. So constructed a new segment can be added at any part. Eighth. To construct the brickwork of converting chambers economically and to prevent loss of heat by radiation we build a thin brick wall around and at a short distance from each chamber. Between the said brick wall and another outer brick wall we place any convenient non-conducting material, such as a mixture of clay and ashes. Ninth. To ensure stability of the outer enclosing brick wall of converting chambers we build flat metal plates therein and employ vertical stays and cross ties to bind and secure the whole. Tenth. To dispense with the labour of shifting the movable flue after a converting chamber has been newly charged we construct a flue to each chamber within the enclosing brickwork, and employ a movable metal plate or door to close the outlet from the chamber which is for the time being the last of the series. Eleventh. To remove the gases remaining in a chamber after conversion has taken place and prevent their escape into the atmosphere we connect a movable syphon or passage with another chamber or with a flue to conduct the said gases to the condensing apparatus. Twelfth. To ensure that there is no leakage of gas past the valves we dispense with the fixed necks and employ movable necks or syphons to connect the chambers to the sulphurous acid flue and also to each other. Thirteenth. To provide means whereby the sulphurous acid or the circulating gases may be heated and the undue heating of the converting chambers thereby avoided, we construct the flues with spaces around or in contact with them, and into these spaces we admit heating gases. Fourteenth. To evenly charge a converting chamber with salt we construct a top with two or more courses of feed holes. Fifteenth. To render durable the steam jet nozzles and the throats through which the evolved hydrochloric acid and other gases are forced we construct such nozzles and throats of glass or earthenware. By throats we mean constricted passages through which the gases are caused to flow by the action of a jet of steam.

An improved composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables. W. Morgan-Brown, engineer and patent agent, 38, Southampton Buildings, London, and 13, Rue Gaillon, Paris. (A communication from Frédéric-Oscar Möller, of 22, Rue Lavoisier, Paris.) October 17, 1872.—No. 3067. This invention is for a composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables, and is composed of gas-tar, marl, acetate of lead, alum, and sulphate of ammonia.

Improvements in the treatment of beer in order to prevent and remove acidity. H. Bethell, brewer, Victoria Street, Westminster. October 18, 1872.—No. 3080. This invention consists in the combined use of carbonates of potash and carbonates of ammonia in the treatment of beer in order to preserve it or prevent it becoming acid, and also to remove acidity from sour beer.

NOTES AND QUERIES.

Zinc Powder.—(Reply to R. A. R.)—Metallic zinc is somewhat brittle at ordinary temperatures, but heated to 200°, it may be readily pulverised in an iron mortar heated to the same temperature.

Deodorising Naphtha.—(Reply to Peter Trumble.)—You may greatly improve the oil by distilling it over quick-lime first, and filtering it next over granulated and freshly burnt wood-charcoal, but this will not entirely remove the smell.

Crystallising Pan for Nitrate of Lead.—(Reply to "Constant Subscriber.")—Use a leaden pan jacketted with iron if you use steam, and if fuel, let the lead rest on an iron plate so as to protect it from the direct action of the flame.

Crystallising Pan for Nitrate of Lead.—Some time ago I had a quantity of nitrate of lead to crystallise and the same difficulty presented itself. I found, however that it crystallised in a large stoneware pan without much trouble. The stone pan was put into a non-seam jacket with an india-rubber washer between them; and the steam was held in by the weight of the pan, though of course much pressure cannot be used.—B. P. M.

MEETINGS FOR THE WEEK.

MONDAY, 19th.—London Institution, 4.
TUESDAY, 20th.—Royal Institution, 3. Mr. J. H. Parker, "On Roman History and Architecture."
—— Civil Engineers, 8.
—— Anthropological, 8.
—— Zoological, 8.30.
WEDNESDAY, 21st.—Society of Arts, 8.
—— Pharmaceutical, 11 a.m. (Anniversary.)
THURSDAY, 22nd.—Royal Institution, 3. Prof. Tyndall, "On Light."
FRIDAY, 23rd.—Royal Institution, 9. Mr. Spottiswoode, "On the Spectra of Polarised Light."
—— Quekett Microscopical Club, 8.
SATURDAY, 24th.—Royal Institution, 3. Mr. J. Morley, "On the Historical Method."

THE CHEMICAL NEWS.

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MANGANESE A SUBSTITUTE FOR NICKEL IN GERMAN SILVER.

In a letter to the *Times*, Dr. Percy, referring to the high price of nickel, says:—

"With your permission, I will now disclose, for the first time, a fact which may, perhaps, surprise, and will certainly interest, electro-platers. More than 20 years ago I was engaged, at the largest German-silver works in this country, in an investigation which had for its object the discovery, if possible, of a substitute for nickel in German silver. The result was successful; every difficulty was surmounted, and an alloy was produced on a manufacturing scale which so perfectly resembled German silver that it was sold as such by way of experiment to electro-platers accustomed to the use of that alloy, without their discovering any difference between the two. The substitute was the metal manganese, and, although this metal cost very much less than nickel, yet it was decided for commercial reasons not to proceed further in the matter, the manufacture of German silver being at the time highly remunerative. The firm to which I have alluded has it in its power at any time to introduce the manganese alloy, and if it should be unwilling to do so it will certainly be done by other persons. At present I refrain from making known either the composition of this alloy or the details necessary to guide the manufacturer, though it is my intention to publish both on a future occasion. What I here announce will, I trust, serve as a hint to practical metallurgists, and may induce them to work at the subject."

In consequence of the interest which this subject is now causing, it will perhaps be useful if we remind our readers of a paper on "Alloys of Copper, Tin, Zinc, and Lead, with Manganese," by Mr. J. Fenwick Allen, F.C.S. This paper was read at the Liverpool meeting of the British Association in 1870. We extract the following:—

"Having obtained a comparatively pure oxide of manganese, and having mixed this with oxide of copper, not metallic copper, together with wood charcoal, all finely ground and intimately mixed, the charge was put into a plumbago crucible, then heated in an air-furnace at an intense heat for from three to four hours. It was found when the pot was taken out, that, still suspended in the charcoal, and not run down to the bottom, were innumerable fine shots of a bright white metal; these being separated by washing and placed again in the crucible and heated, fused, I may say easily, into a prill or button covered with a green layer of vitreous slag.

"The process was continued until some ingots were produced, and in these experiments were made as to their malleability and ductility. This knife-blade is the first piece that was successfully passed through the rolls.

"The alloy was found to be very hard and very brittle when hot, but when cold, although still hard, it rolled with ease and was highly elastic.

"The proportions of the alloy were about—

Copper	75 per cent.
Manganese ..	25 ,,

"When the simple alloy had been produced in sufficient quantities, compound alloys with zinc were tried in various proportions, and these again rolled with complete success.

"Certain mixtures of copper, zinc, and manganese possess the advantage both over German silver and yellow metal, that, whereas the one will only roll cold, and the other hot, the manganese alloy rolls from hot to cold.

"The laboratory experiments having been completed, an air-furnace was built in which a 100-lb. plumbago crucible was used.

"The results were precisely the same as those obtained in the laboratory, only it was found that, by stirring the charge a few minutes before the crucible was taken out of the fire, by far the greater portion of the metal that before was in small fine shot, needing very careful washing, now settled to the bottom of the pot, and could be poured out as a bar or ingot, the slag also melting, and the unconsumed charcoal floating on the top. This experiment was continued until several hundredweights of the alloy were produced, so that it may be subjected to various tests, and also that some approximate estimate of its cost and value might be formed.

"As a simple alloy, in which the proportions of manganese ranged from 5 per cent to 30 per cent, it is both malleable and ductile, with a tenacity considerably greater than that of copper.

"With zinc a compound alloy very closely resembling some of the qualities, not the best, of German silver is obtained. The alloy of copper and manganese would also combine with tin, lead, and other metals, and from these castings were made which were applied as bearings for machinery.

"A furnace planned by Mr. Siemens has supplied the intense heat needed, with a non-oxidising flame, in a quiet atmosphere.

"It merely remains for me now to place before you the following series of specimens:—

"1st. Manganese and copper in various proportions from 35 per cent to 5 per cent of iron, as ingot, sheet, or wire.

"2nd. Copper, zinc, and manganese, also in different proportions, and in a variety of applications.

"3rd. Copper, zinc, manganese, and tin as ingots and as bearing.

"4th. Copper, manganese, and tin in several different proportions as bars.

"5th. Copper, manganese, and lead."

The metallurgy of manganese has perhaps received its most important development from the researches of Mr. Hugo Tamm, first published in our pages eight months ago. He says—"The metal obtained by the new process is not pure manganese; it is to manganese that which cast-iron is to iron, and I will henceforth call it cast-manganese. But it is prepared with common materials, and the superiority of the process consists in this, that with a given manganese ore the cast-manganese is purer than the corresponding metal extracted by another process, and lastly, it is obtained with greater facility, greater security, and at less expense than with ordinary means, and, what is most important of all, it may be prepared in unlimited quantity.

"My endeavours were directed from the first to the reduction of manganese ores in presence of a flux.

"*Preparation of the Fluxes.*—Two fluxes are required for successful and really practical operations in the smelting of manganese. One which I will call flux No. 1, or white flux, and which is obtained by mixing well together common ground bottle glass free from lead, quick-lime, and fluor-spar.

"The second flux, flux No. 2, or black flux, is theoretically required for the smelting of manganese, and it can be used in practice. It is formed by mixing together flux No. 1, native oxide of manganese of good quality, very fine charcoal powder, soot, or lamp-black.

"This flux may be used just as it is obtained after mixing. But it is best to incorporate the mass by adding enough of an oil to form a thick paste, and heating the whole at a high temperature in a closed crucible. The oxide of manganese is reduced to the state of protoxide; the flux assumes a fine olive-green colour.

"But on the whole, the best and safest mode of operating is the following:—A mixture is made of—

Flux No. 1	34 parts.
Lamp-black, or soot of good quality	$5\frac{1}{2}$,,
Peroxide of manganese, native, of good quality	$60\frac{1}{2}$,,

And it is smelted as will be hereafter described. $17\frac{1}{2}$ parts of cast-manganese are obtained, and the slag, which presents a fine olive-green colour, is ground. It is saturated with protoxide of manganese, to which it owes its colour, and it forms an admirable flux, either for the smelting of manganese ores or for their docimastic assaying.

"*Preparation of the Crucibles.*—The following plan which I devised is so simple and so effective that not only is every difficulty removed, but special advantages are attached to its use.

"Three parts of plumbago and 1 part of loam or fire-clay are mixed together, and made into a thick paste with water, and the crucible is as equally as possible lined with this paste, which holds firmly to its sides. The thickness of the lining varies with the size of the crucible, but with the largest crucibles it should not exceed half an inch.

"*Smelting of Manganese Ores.*—Any crucible which will stand a white heat for several hours without softening can be used. It is lined with loam and plumbago, as I have previously described, and then the following mixture is introduced into it:—

Native oxide of manganese, of good quality	1000 parts.
Lamp-black or soot, of good quality	91 ,,
Green flux	635 ,,

Oil, in sufficient quantity to merely wet the mixture.

"The mixture is introduced in the crucible and slightly pressed in, and a round cover of thick wood is placed over it. It is carbonised during the smelting, and forms a charcoal cover which protects admirably the mixture from oxidation, and it can be used several times.

"The clay or plumbago cover is placed over the crucible, and the joint is luted with a little thin fire-clay. A small aperture is kept to allow the gases to escape.

"The crucible is then placed in a wind- or blast-furnace, and slowly heated so long as fumes escape from the crucible; the heat is rapidly increased until it reaches white heat, and the furnace is maintained at that high temperature for several hours.

"When it is thought that the operation is done, the fire is allowed to burn away, and the crucible is left to cool. The cover is then removed by means of a chisel introduced in the joint. The crucible is turned upside down, and shaken until the slag and metal fall down. The button of metal is detached from its slag with a hammer, and introduced in well-corked or stoppered vessels perfectly dried.

"The slag, which has a fine olive-green colour, breaks up in fragments with large faces affecting a pseudo-crystalline structure, but the grain is really crystalline. It is ground, and used as flux in a second smelting. It is advisable after each smelting to add to the slag, in order to make it more fusible, about $\frac{1}{10}$th of the white flux.

"The mixing of manganese ore, lamp-black, and flux is not an indifferent operation, and to ensure perfect success it should be done in the following way:—The oxide of manganese should be first of all thoroughly mixed with the lamp-black. This mixture should be pretty roughly mixed with the flux, and then oil should be added. By so doing, lamp-black and oxide of manganese remain united during the mixing, and act upon each other during the smelting, before the flux begins to melt, so that the oxide is reduced to the metallic state before the flux can dissolve any portion of it. The residue of carbon left by the burnt oil assists in reducing the oxide of manganese, and in preventing the flux from acting upon it before it has been reduced to the metallic state.

"The only real improvement of importance would be the addition to the flux of a substance which, in small quantities, would assist in obtaining a cast-manganese of a superior quality.

"*Refining of Cast-Manganese.*—There is little doubt that, as soon as manganese is prepared on the large scale and at a comparatively low price, some uses will be found for it. I think that, in certain operations, it might form a good substitute for potassium and sodium; and in that case cast-manganese, such as is obtained after the smelting of its ore, could be used with advantage; but should a purer kind of metal be required for the manufacture of certain special alloys, cast-manganese would have to be refined.

"The simplest way of refining manganese is the method which has been proposed by Berthier, I believe, and which consists in re-melting the cast-manganese coarsely powdered with about one-eighth of carbonate of manganese. The mixture is introduced into a refractory clay crucible, and covered over with a wooden cover similar to the one used in the smelting, to prevent oxidation.

A NEAT METHOD OF TESTING WITH BUNSEN'S FLAME.

By CHARLES HUSON,
Demonstrator in Chemistry, Queen's College, Liverpool.

In principle, this method is similar to that of the Bunsen-stick recommended in some of the recent text-books, but, I think, will be found to be an improvement on it, both in neatness and delicacy, and also in expeditiousness. A thin piece of platinum wire is taken, and a small double loop or cage 2 or 3 m.m. in diameter made at one end. This loop is moistened with water and then dipped into powdered cream of tartar, a small portion of which will adhere. On heating for a few seconds in the reducing zone of the Bunsen flame, the cream of tartar will, of course, be converted into a mixture of carbon and potassium carbonate. All that now remains to be done is to dip this porous mass of carbon into a solution of the substance to be tested, or (in the case of a solid body) to moisten it with water and attach a grain or two of the assay to it, and, having first driven off the moisture by holding the wire at some distance above the flame, to insert the carbon tip into the upper reducing flame for a few moments. If the solution of the assay be concentrated, or if a solid portion be used, the reduced metal will be plainly visible to the naked eye; but, in the case of a dilute solution being used, the metallic grains can only be seen by rubbing the carbon tip in a small agate mortar with a few drops of water.

In testing a volatile substance, *e.g.*, arsenic, antimony, cadmium, &c., a small evaporating basin, half filled with cold water, should be held just above the carbon tip, and almost in contact with it, upon which an incrustation or mirror will be found.

As instances of the extreme delicacy of this mode of testing, I may mention the following, among other results of careful experiments which I have made:—

(1). A solution of 0·1 grm. of As_2O_3 in 50 grms. of water was made, and the carbon tip dipped once into it. On heating, the arsenical mirror was produced almost instantaneously upon the evaporating dish held in the flame.

(2). The carbon tip was moistened with a solution of 0·1 grm. of crystallised copper sulphate in 10 grms. of water. On pressing the residue in an agate mortar, minute copper scales were distinctly visible.

(3). A solution of 0·1 grm. of silver nitrate in 40 grms. of water was used, with a corresponding result, only that the silver scales were more distinct.

I also tried a solution of As_2O_3 of half the strength of the above-mentioned one (viz., 1 of As_2O_3 in 1000 of H_2O), and even in this case got a slight mirror, which dis-

appeared when moistened with chloride of soda. As in each of the above experiments the portion of solution actually used was less than 0·05 grm., the amount of metal present will be seen to have been extremely minute, viz.:—

In (1) .. 0·0001 grm. As_2O_3 =0·000075 As.
,, (2) .. 0·0005 ,, $CuSO_45H_2O$=0·00013 Cu.
,, (3) .. 0·00012 ,, $AgNO_3$ =0·00008 Ag.

In testing for a volatile metal, care must be taken to heat the cream of tartar long enough to expel the whole of the inflammable gas before heating with the assay, otherwise the mirror will be obscured by, or contaminated with, a deposit of soot, which will of course destroy the delicacy of the test.

In the case of non-volatile bodies this precaution need not be taken; on the contrary, it is better to only partially carbonise the tartar, since it has then a more strongly reducing effect. The presence of a very slight trace of sulphur may be detected by moistening the residue, after heating, on lead-paper or silver. I have tried moistening the carbon tip with strong solution of KCy, but without increasing the delicacy of the test.

In conclusion, I must mention that the idea of using cream of tartar originated with my friend and teacher, Professor G. Hamilton, F.C.S.

ON THE

EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON, STEEL, AND BISMUTH BARS; AND IN INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

PART I.

I PURPOSE giving, in a series of papers, the results of a prolonged and careful research on the above subject.

Introduction.—In 1842 Joule discovered that when a current of electricity was passed through a helix which enclosed a bar of iron, the latter, on its magnetisation, suddenly elongated a minute fraction of its length.

To present clearly Dr. Joule's experiments, we will give these abstracts from the excellent paper which he published in the *Philosophical Magazine* in 1847.

"In order to ascertain how far my opinion as to the invariability of the *bulk* of a bar of iron under magnetic influence was well founded, I devised the following apparatus. Ten copper wires, each 110 yards long and $\frac{1}{20}$th of an inch in diameter, were bound together by tape, so as to form a good, and at the same time very flexible, conductor. The bundle of wires thus formed was coiled upon a glass tube 40 inches long and $1\frac{1}{2}$ inches in diameter. One end of the tube was hermetically sealed, and the other end was furnished with a glass stopper, which was itself perforated so as to admit of the insertion of a capillary tube. In making the experiments, a bar of annealed iron, 1 yard long and $\frac{1}{2}$ an inch square, was placed in the tube, which was then filled up with water. The stopper was then adjusted, and the capillary tube inserted so as to force the water to a convenient height within it.

"The bulk of the iron was about 4,500,000 times the capacity of each division of the graduated tube; consequently a very minute expansion of the former would have produced a very perceptible motion of the water in the capillary tube; but, on connecting the coil with a Daniell's battery of five or six cells (a voltaic apparatus quite adequate to saturate the iron), no perceptible effect whatever was produced either in making or breaking contact with the battery, whether the water was stationary in the stem, or gradually rising or falling from a change of temperature. Now had the usual increase of length been unaccompanied by a corresponding diminution of the diameter of the bar, the water would have been forced through twenty divisions of the capillary tube every time that contact was made with the battery.

"Having thus ascertained that the bulk of the bar was invariable, I proceeded to repeat my first experiments with a more delicate apparatus, in order, by a more careful investigation of the laws of the increment of length, to ascend to the probable cause of the phenomenon.

"A coiled glass tube, similar to that already described, was fixed vertically in a wooden frame. Its length was such that when a bar 1 yard long was introduced so as to rest on the sealed end, each extremity of the bar was a full inch within the corresponding extremity of the coil. The apparatus for observing the increment of length consisted of two levers of the first order, and a powerful microscope situated at the extremity of the second lever. These levers were furnished with brass knife-edges resting upon glass. The connection between the free extremity of the bar of iron and the first lever, and that between the two levers, was established by means of exceedingly fine platinum wires.

"The first lever multiplied the motion of the extremity of the bar 7·8 times, the second multiplied the motion of the first 8 times, and the microscope was furnished with a micrometer divided into parts, each corresponding to $\frac{1}{2250}$th of an inch. Consequently, each division of the micrometer passed over by the index indicated an increment of the length of the bar amounting to $\frac{1}{138528}$th of an inch.

"The quantities of electricity passing through the coil were measured by an accurate galvanometer of tangents, consisting of a circle of thick copper wire 1 foot in diameter, and a needle $\frac{1}{2}$ an inch long furnished with a suitable index.

"The quantities of magnetic polarity communicated to the iron bar were measured by a finely suspended magnet, 18 inches long, placed at the distance of 1 foot from the centre of the coil. This magnetic bar was furnished with scales precisely in the manner of an ordinary balance, and the weight required to bring it to a horizontal position indicated the intensity of the magnetism of the iron bar under examination.

"After a few preliminary trials, a great advantage was found to result from filling the tube with water. The effect of the water was, as De la Rive had already remarked, to prevent the sound. It also checked the oscillations of the index, and had the important effect of preventing any considerable irregularities in the temperature of the bar.

"The first experiment which I shall record was made with a bar consisting of two pieces of well-annealed rectangular iron wire, each 1 yard long, $\frac{1}{4}$ of an inch broad, and about $\frac{1}{8}$th of an inch thick, The pieces were fastened together so as to form a bar of nearly $\frac{1}{4}$ of an inch square. The coil was placed in connection with a single constant cell, the resistance being further increased by the addition of a few feet of fine wire. The instant that the circuit was closed, the index passed over one division of the micrometer. The needle of the galvanometer was then observed to stand at 7° 20′, while the magnetic balance required 0·52 of a grain to bring it to an equilibrium. It had been found by proper experiments that a current of 7° 20′ passing through the coil was itself capable of exerting a force of 0·03 of a grain upon the balance; consequently the magnetic intensity of the bar was represented by 0·49 of a grain. On breaking the circuit, the index was observed to retire 0·3 of a division, leaving a permanent elongation of 0·7, and a permanent polarity of 0·42 of a grain. More powerful currents were now passed through the coil, and the observations repeated as before, with the results tabulated below.

* Read before the National Academy of Sciences, in Cambridge, Mass.

"Experiment I.

Deflection of Galvanometer.	Tangent of Deflection.	Elongation or Shortening of Bar.	Total Elongation.	Magnetic Intensity of Bar.	Square of Magnetic Intensity divided by Total Elongation.
− 7° 20′	128	1·0 E.	1·0	−0·49	240
0	0	0·3 S.	0·7	−0·42	252
− 9 30	167	2·9 E.	3·6	−0·93	240
0	0	1·2 S.	2·4	−0·74	228
−14 48	264	5·9 E.	8·3	−1·42	243
0	0	3·8 S.	4·5	−1·00	222
−23 10	428	10·3 E.	14·8	−1·87	236
0	0	7·6 S.	7·2	−1·26	220
−47 25	1088	16·1 E.	23·3	−2·22	211
0	0	13·9 S.	9·4	−1·35	194
−58 50	1653	14·8 E.	24·2	−2·21	202
0	0	13·3 S.	10·9	−1·35	168."

Dr. Joule now reversed the current in the helix, and found that a current which deflected the needle 6° 15′ *shortened* the bar 3·4 div., and that after the current was broken its magnetic intensity was found reduced from −1·3 (the permanent intensity previously given by 47° 25′, see preceding table) to −17. He then passed a current of 9° 55′, and this he found was sufficient, not only to remove the former minus polarity of the bar, but also to give it a permanent polarity of +0·25, and yet to leave the bar with 6·6 of the elongation belonging to its previous minus polarity.

Taking Joule's observations while the current was passing around the bar, we have for the current of 6° 15′ a magnetic intensity of −0·12, and for the current of 9° 15′ a *plus* magnetic polarity of 0·57. We call attention to these results because subsequent experimenters * seem to be unaware of these observations of Dr. Joule, who here first shows that a feeble current will demagnetise, and even reverse, the polarity of a bar which has previously required a far more powerful current to give it its permanent magnetic charge. In the experiment given above, the ratio of the current intensities of permanent magnetisation and of demagnetisation is 1088 to 175.

Dr. Joule now successively replaced the above bar by two others, and obtained with them similar results. He then deduces the following important law:—"From the last column of each of the preceding tables we may, I think, safely infer that *the elongation is in the duplicate ratio of the magnetic intensity of the bar*, both when the magnetism is maintained by the influence of the coil, and in the case of the permanent magnetism after the current has been cut off. The discrepancies observable will, I think, be satisfactorily accounted for when we consider the nature of the magnetic actions taking place. When a bar experiences the inductive influence of a coil traversed by an electrical current, the particles near its axis do not receive as much polarity as those near its surface, because the former have to withstand the opposing inductive influence of a greater number of magnetic particles than the latter. This phenomenon will be diminished in the extent of its manifestation with an increase of the electrical force, and will finally disappear when the current is sufficiently powerful to saturate the iron. Again, when the iron, after having been magnetised by the coil, is abandoned to its own retentive powers by cutting off the electrical current, the magnetism of the interior particles will suffer a greater amount of deterioration than that of the exterior particles. The polarity of the former may indeed be sometimes actually reversed, as Dr. Scoresby found it to be in some extensive combinations of steel bars. Now whenever such influences as the above occur, so as to make the different parts of the bar magnetic to a various extent, the elongation will necessarily bear a greater proportion to the square of the magnetic intensity measured by the balance than would otherwise be the case. For similar causes the interior of the bar will in general receive the neutralisation and reversion of its polarity before the exterior, and hence we see in the tables that there is a considerable elongation of the bar after the reversion of the current, even when the effect upon the balance has become imperceptible, owing to the opposite effects of the interior and exterior magnetic particles."

Joule now experimented on a bar of unannealed iron, and on three bars of soft steel. As these bars had considerable degrees of retentive power, the anomalies occasioned by the above-described actions did not exist to any considerable extent, and they gave a confirmation of the law that the elongation is proportional, in a given bar, to the square of the magnetic intensity.

The next bar he experimented with was of moderately hardened steel. This bar was slightly increased in length every time that contact with the battery was broken, although a considerable diminution of the magnetism of the bar took place at the same time. He says—"I am disposed to attribute this effect to the state of tension in the hardened steel, for I find that soft iron wire presents a similar anomaly when stretched tightly."

In a subsequent communication, contained in the same volume of the *Philosophical Magazine*, Dr. Joule gives accounts of numerous experiments made upon wires and bars of soft iron, cast-iron, soft and hardened steel, subjected to various pressures and tensions while they were magnetised. As an example of the effect of *tension* on the phenomena, he states that in the case of a bar 1 foot long and ¼ of an inch in diameter, a tensile force of about 600 lbs. caused all the phenomena of changes of length to disappear, even with a current which produced a deflection of 58° in the needle of the tangent galvanometer; but when a current of 61° was passed around this bar, subjected to a tension of 1040 lbs., it *shortened* 2·8 div. With a tension of 1680, and the same current, the bar shortened 4·5 divisions. Joule, from his experiments, deduces this law, viz.—*In the case of tension the shortening effect is proportional to the current traversing the coil multiplied by the magnetic intensity of the bar.* He further states that "it is extremely probable that the shortening effects are proportional, *cæteris paribus*, to the square root of the force of tension."

In the case of bars of cast-iron he finds that their elongation is equal, if not superior, to those of soft iron, when magnetised to the same degree; and an increase of tension in them does not produce half the retraction which is caused in soft iron bars in similar circumstances.

Bars of soft steel acted like the bars of iron, but the superior retentive powers of the former enabled him to trace better the elongating effects of the permanent magnetism, which diminished with the increase of tension, and at last disappeared altogether; but with bars of perfectly hardened steel no sensible change in their lengths was produced by charges of *permanent* magnetism, and the *temporary* shortening effect of the coil was proportional to the magnetism multiplied by the current traversing the coil. The shortening effect did not, in these cases, sensibly increase with the increase of tension.

On subjecting bars of wrought- and cast-iron and soft steel to pressure, Joule found that it had no sensible effect upon the extent of their elongation. A hard steel cylinder a foot long, when submitted to the same experiments, with a pressure of 80 lbs., "suffered a diminution of length equal to 0·1 of a division of the micrometer, with a current capable of giving a magnetic polarity of 1·7."

At the termination of his paper, Dr. Joule gives the following "*postscript*:"—"I have already, in the former part of this paper, described an experiment which indicated that no alteration in the *bulk* of a bar of soft iron could be produced on magnetising it. I thought, however, that it would be interesting to confirm the fact by an ob-

* Wiedemann, *Pog. Ann.*, c., p. 235; also R. W. Wilson, "Demagnetisation of Electro-Magnets," *Amer. Journ, Sci.*, 3rd series, vol. iii., p. 346.

servation of the alteration of the dimensions of the iron at right angles to the direction of its polarity. For this purpose I took a piece of drawn iron gas-piping, 1 yard long, $\frac{3}{16}$ths of an inch in bore, and $\frac{3}{16}$ths of an inch in thickness. A piece of thick, covered copper wire was inserted into this tube, and bent over the outside of it. The lower extremity of the iron tube being fixed, and the upper end being attached to the micrometrical apparatus, each division of which corresponded to $\frac{1}{138528}$ths of an inch, I obtained * * * results which show that the length of the tube was diminished, in order to make up for the increase of its diameter, which, in this instance, was in the direction of the polarity. The quantity of the shortening effect, viz., 3·4, is, however, only one-third of that due to the maximum elongation of soft iron bars as observed in the first section. This is probably owing to the grain of the iron being in cross directions with respect to the polarity in the two cases; and partly, perhaps, to the iron tube not being fully saturated with magnetism. The experiment is worth repeating, especially as it affords a means of studying the magnetic condition of closed circuits."

Remarking on the cause of the phenomena of elongation, Dr. Joule says—"The law of *elongation* naturally suggests the joint operation of the attractive and repulsive forces of the constituent particles of the magnet as the cause of the phenomena. On the other hand, the fact that the *shortening effect* is proportional to the magnetic intensity of the bar multiplied by the current traversing the coil, seems to indicate that, in this case, the effect is produced by the attraction of the magnetic particles by the coil. But then it will be asked—Why so remarkable an augmentation of the effect is produced by the increase of tension in the case of the soft iron bars? When we are able to answer this question in a satisfactory manner, we shall probably have a much more complete acquaintance with the real nature of magnetism than we at present possess."

This full account of Dr. Joule's remarkable research is here presented in order to give an exposition of our present knowledge of this subject, and clearly to set forth the relations which my own attempts bear to his labours. Here Joule, the discoverer of these phenomena, has given us almost all the knowledge we have, up to this time, possessed in reference to their characteristics and their laws. That a subject so fascinating should not have been eagerly followed up appears strange; especially so, when it seems highly probable that the faithful study of these actions may one day give us an insight into the dynamic nature of electro-magnetisation, and thus lead the investigator into a fruitful field of research.

No one can duly appreciate this work of Joule's until he attempts the confirmation of his results; then the difficulties of the research and the skill and acumen of this eminent physicist will be properly estimated.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 15, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. R. J. Deeley, J. H. Baldock, and H. Tylston Hodgson were formally admitted Fellows of the Society. The names of Messrs. Archibald Kitchin, James Emerson Reynolds, Robert Wild, and Walter Odling, were read for the first time. For the third time—Messrs. William H. Greenwood and Walter Hills, who were balloted for and duly elected.

The President then called on Dr. ARMSTRONG to deliver his lecture on "*Isomerism.*"

The lecturer, after noticing the comparatively broad signification formerly attached to the term isomeric as applied indifferently to all bodies having the same percentage composition, proceeded to define the terms "polymeric," "metameric," and "isomeric" as now generally accepted, citing the four butylic alcohols and the three dioxybenzenes in illustration of isomerism, and allylic alcohol, propionic aldehyde, propylene oxide, and acetone as examples of metameric compounds, stating, however, that metamerism and isomerism are closely allied phenomena, and that in many instances the one merges almost insensibly into the other. Isomerism is generally regarded as caused by a different arrangement of the same radicals; thus, by the action of chlorine on propane, two monochloropropanes are simultaneously produced, one represented by the expression—

$$\begin{cases} CH_2Cl \\ CH_2 \\ CH_3 \end{cases}$$

the other by—

$$\begin{cases} CH_3 \\ CHCl \\ CH_3 \end{cases}$$

the chlorine atom in these two compounds occupying different positions relatively to the carbon atoms, and from each of these derivatives, by the action of various reagents, other isomeric substances may be obtained, the mutual relations of which may be similarly explained.

Again, benzene, as far as we know, does not form isomeric mono-derivatives, and this circumstance, taken in conjunction with its forming additive compounds with the monad elements, induced Kekulé to represent it by the symbol—

```
   HC=CH
   /    \
HC       CH
  \\    //
   HC-CH
```

in which, as the carbon and hydrogen atoms are symmetrically arranged, we should expect to obtain only one of each of the mono-substitution derivatives. Of di-substitution compounds, however, three isomeric forms are known, and these are symbolised by assigning to the radicals different relative positions; for example, the three dioxybenzenes—(I.) hydroquinone, (II.) pyrocatechin, and (III.) resorcin—would be represented thus—

```
      I.                  II.                  III.
   HC=COH              HC=COH               HC=COH
   /    \              /    \               /    \
HC       COH        HC       CH          HC       CH
  \\    //            \\    //             \\    //
   HC-CH               HC-COH             HOC-CH
```

Metameric compounds, on the other hand, may be represented as built up of different radicals; for example—

$$\begin{cases} CH_3 \\ CH_2 \\ COH \end{cases} \qquad \left.\begin{cases} CH_3 \\ CH \\ CH_2 \end{cases}\right\} O \qquad \begin{cases} CH_3 \\ CO \\ CH_3 \end{cases} \qquad \begin{cases} CH_2 \\ CH \\ CH_2(OH) \end{cases}$$

Propionic Aldehyde. Propylene Oxide. Acetone. Allylic Alcohol.

This is apparently a satisfactory explanation of the phenomena in question, and has, no doubt, greatly forwarded experimental research, but still it is difficult to reconcile many facts which exist with this hypothesis of position; for instance, when ethyl iodide acts on argentic nitrite, it would be expected that argentic iodide and ethylic nitrite—

$$N''' \begin{cases} O \\ (C_2H_5O) \end{cases}$$

would be formed. There is, however, simultaneously produced an isomeric compound, nitro-ethane—

$$N^{v} \begin{cases} O \\ O \\ (C_2H_5) \end{cases}$$

Again, Linnemann has found that the decomposition of the nitrite of the propylamine, prepared from normal propylic alcohol, does not yield propylic alcohol, as might be expected, but isopropylic alcohol, and, by treating normal butylic alcohol in a similar way, it may be converted into isobutylic alcohol, and this, in turn, into the tertiary alcohol—

$\left\{\begin{array}{l}CH_3\\CH_2\\CH_2.OH\end{array}\right.$	$\left\{\begin{array}{l}CH_3\\CH.OH\\CH_3\end{array}\right.$	$\left\{\begin{array}{l}CH_3\\CH_2\\CH_2\\CH_2.OH\end{array}\right.$
Propylic Alcohol.	Isopropylic Alcohol.	Butylic Alcohol.
$\left\{\begin{array}{l}CH(CH_3)_2\\CH_2.OH\end{array}\right.$	$C(CH_3)_3.OH$	
Isobutylic Alcohol.	Tertiary Butylic Alcohol.	

The assumption that these results are the consequence of intermolecular change appears to be improbable, and they cannot be readily accounted for in any other way which shall be in accordance with the position theory. These anomalous reactions, however, and others of a similar nature, are capable of explanation on the assumption that different amounts of force have been expended in the formation of the isomeric compounds—in other words, isomerides and metamerides are bodies possessed of different potential energies. This view is borne out by the fact that, in the few instances in which the heat of combustion of isomeric organic compounds has been determined, they give different results, as is the case with the metameric compounds, ethylic acetate and butyric acid. This hypothesis is, at all events, capable of experimental investigation and of numerical expression, which is not the case with the position theory. At present, however, we possess no experimental data to enable us to state which members of any series have the lowest, and which the highest, potential energy, but it is probable that the so-called normal primary members of the fatty series possess the lowest potential energy, and are relatively the most stable, since Berthelot has pointed out that of two metameric compounds that which has the lowest boiling-point and density furnishes the most heat on combustion. Of aromatic compounds, one would be inclined by analogy to regard the members of the terephthalic series as the compounds of lowest potential energy and those of the phthalic series the highest.

The author concluded his comprehensive lecture by some remarks on the relation between the melting-points of various isomeric members of the aromatic series and of groups of their haloid derivatives.

The President, in alluding to the deep interest with which he had listened to Dr. Armstrong's discourse on this complex subject, said that the investigation of the potential energy of organic compounds commended itself to chemists as affording a key to the interpretation of the mystery of isomerism. The present way of regarding this as caused by the different grouping of radicals and molecules must be considered as merely provisional, and simply useful as enabling us to co-ordinate facts. In respect to the internal transference of molecules or atoms in organic substances, it was not a new subject; the conversion of ammonium cyanate into urea, and the reconversion of urea into ammonium cyanate, had never been held to contravene the opinion that this substance contained different radicals. There could be no doubt that the physical properties of the various derivatives of benzene afforded great assistance in their classification, and, as the transformation of these compounds is always accompanied by evolution or absorption of heat, the determination of the amount of heat developed by their combustion would be an important element in ascertaining their relations to one another.

Dr. Wright said that in listening to the able address given by the lecturer, he was glad to hear that he did not consider matter to be made up of indivisible particles or atoms, for we should carefully distinguish between the use of symbols to express facts and the employment of them to signify the nature of the body. He might mention that there was another symbolic expression for benzol besides Kekulé's, namely, the following:—

$$\begin{array}{ccccc}1 & & 2 & & 6\\ C & — & C & — & C\\ | & & | & & |\\ C & — & C & — & C\\ 4 & & 3 & & 5\end{array}$$

arranged in space in a wedge-shaped form, and having the C's numbered 6 and 5 joined to 1 and 4 respectively; but for his part he failed to see how isomerism could be explained by a difference in the position of the atoms, since these particles or atoms must be continually moving about amongst themselves. He would propose to substitute for the term molecule the word "metropneum" to express the unit of volume of 1 gramme of hydrogen under given conditions of temperature and pressure, and the term "metrogram" for the concrete weight in grammes of a proportion of any given element.

Dr. Mills observed that it was now eight years since he had communicated to the *Philosophical Magazine* what he believed was the first dynamical theory that had been advanced in explanation of this subject, one which was parallel to that proposed by Dr. Armstrong. For instance, in the formation of roseo-chloride of cobalt the action must take place at a low temperature; and if we heat this it becomes converted into the purpureo-chloride of cobalt isomeric with the first. He considered that the second compound had been formed from the first by a further expenditure of energy, and that when the operation was reversed this energy would again be developed. The three nitrobenzoic acids he had investigated afforded another example, the first one melting at 127° when heated, or by the continued action of nitric acid becomes converted into one melting at 136°, and this again into one melting at 140°. He believed that determinations of the heat developed by the combustion of organic compounds would profit but little for the solution of the question, there being no fixed starting-point by which to compare the results. A far more important thing would be the determination of the real units of mass, that is the weights of bodies which perform a unit of work. He had done this for eight nitrates; and many would be surprised to hear that with respect to potassium and sodium the unit of work performed was the same.

Dr. Debus, after having asked Dr. Mills some questions as to the unit of mass and unit of work, urged, as an objection to Dr. Armstrong's remarks on the difference of potential energy of isomeric substances, that this did not satisfactorily explain why the mutual action of silver cyanide and ethylic iodide yielded two isomeric substances at the same time.

Professor Heaton observed that several examples of change occurred in mineral chemistry, as, for example, in mercury iodide and sulphide, and in antimony sulphide. The change from one to another of their metameric or isomeric forms was accompanied by absorption or evolution of heat, and were not usually explained by chemists on the supposition of a difference in position of the atoms.

Sir Benjamin Brodie said that the lecturer had not given them a cut-and-dried theory, but had suggested the investigation of a class of facts which vary with the isomeric forms of compounds, namely, their thermal properties. He thought this, in direct contradistinction to the theory about the arrangement of atoms, was likely to prove far more profitable as it would establish *facts*; and we had no fact to show that certain arrangements of letters represented certain arrangements of atoms. The present theory of isomerism was founded on our ignorance and not on our knowledge—on what we do not know rather than on what we know: as only three di-derivatives of benzene have as yet been obtained it is concluded that only three can exist, and a theory is founded on this and similar suppositions. He believed the views of Dr. Armstrong would lead to something much more tangible.

Professor Clifford remarked that, speaking from the purely mechanical side of the question, the difference

between potential energy and kinetic energy was that the former was regarded as the energy of position, the latter as the energy of motion; and, as in the case before us there was no argument to show that it was purely an energy of position, the term potential energy would be incorrect, he thought it would be better to use the general term energy. In the theory of magnetic induction we conceived a system of small magnets surrounded by currents; such a free system of magnets moving in space would be stable, and might be considered as analogous to the molecular system of an organic compound. Now suppose two magnets vibrating in stable equilibrium with the north pole of the one directed to the south pole of the other, if we introduce a third magnet the relation of the two first will be altered. In a similar manner if a radical be introduced into a given compound, the bonds which unite the atoms are not the same as when the radical is in a different compound.

Dr. Armstrong, in replying, said he was inclined to regard formulæ as merely symbolical representations of facts; he did not believe, for instance, that ethane contained the radical methane, but that the compound was homogeneous. The graphic formula for benzene alluded to by Dr. Wright he thought decidedly inferior to Kekulé's; one great objection to it being that it did not exhibit so clearly the formation of the additive derivatives; also the motion amongst the atoms of a compound was no valid objection to the position theory, as the atoms were supposed to vibrate within certain limits. With regard to Dr. Mills's researches on the three nitrobenzoic acids, it is possible that the substances examined were mixtures; as at the time the experiments were made the great difficulty there frequently is in separating and purifying closely allied organic compounds was not appreciated; many instances of this are known.

The President having proposed a vote of thanks to the lecturer for his able discourse the meeting adjourned until Thursday, June 5, when papers will be read "On the Dioxides of Calcium and Barium," by Sir John Conray, Bart., and "On Iodine Monochloride," by Mr. J. B. Hannay; a new Ozone Generator will also be exhibited by Mr. Wills.

CORRESPONDENCE.

ARTIFICIAL FIBRIN AS A DIETETIC SUBSTANCE.

To the Editor of the Chemical News.

Sir,—I have much pleasure in forwarding you the results of many trials of the dietetic value of this substance in disease, the mode of development of which I had the honour of describing in your valuable periodical in January, 1872. Hitherto its use has been highly gratifying, and attended with the most perfect success. It promises fair to become invaluable in medical practice, especially in cases of feeble alimentation and deficient nutrition, and second to none in those cases where rejection of food forms a prominent feature of the complaint, or where the appetite and digestive powers are reduced to a minimum.

As fibrinous material it is, of course, highly nutritious, and eminently adapted to all cases where there prevails a deficiency of fibrin in the blood. It is, perhaps, unparalleled in its qualities of lightness and digestibility, and is, moreover, "a great delicacy," and differs remarkably, both in its flavour and effects, from the ordinary boiled egg.

In many urgent cases of rejection of food, &c., it not only generally remains where an otherwise prepared egg would not be tolerated, but its presence in the stomach has been found to create a feeling of want rather than of superfluity, and thus to promote, rather than decrease, the appetite for food.

The production of this substance is within the reach of every sick room, and is effected with great facility.

It is formed, it will be remembered, by exposing albuminous material to the operation or influence of cold water for a given period; and, on account of its great plenteousness, we employ the ordinary hen's egg for its production.

When the shell is broken and removed, and its contents are immersed in cold water for some twelve hours or so, it is found to undergo a chemico-molecular change, and to become solid and insoluble.

This change is indicated by the assumption, by the transparent "white of the egg," of an opaque and snowy-white appearance, which far surpasses that of the ordinary egg. The product and the fluid in which it is immersed must now be submitted to the action of heat unto the boiling-point, when the fibrin will be found ready for use.—I am, &c.,

John Goodman, M.D.

Southport, May 7, 1873.

ROSOLIC ACIDS, CORALLINES, OR AURINES.

To the Editor of the Chemical News.

Sir,—The abstract in your last number, at page 244, of the paper by MM. Prud'homme, following various others on the same subject, induces me to say a word or two, although I am not as yet prepared to give a detailed account of my own experiments and results.

Until quite lately it was not thought possible to obtain a crystallisable product by the well-known process of treating phenol with sulphuric and oxalic acids, but crystals have at length been obtained by elaborate and roundabout processes of purification, far too expensive and unproductive for commercial purposes. Now I obtained crystals easily quite three years ago, and two years ago I so far improved the process as to obtain a "melt" which at the first boiling with water was wholly converted into a mass of crystals. The crystallisation takes place in a somewhat remarkable manner: the substance appears to become more and more dissolved in the boiling water, until suddenly—the boiling being continued—the liquid begins to glitter like aventurine, and the whole substance. both dissolved and undissolved, becomes crystalline. The substance thus obtained, when re-crystallised from methylated spirit, yields very fine crystals, sometimes quite half an inch long. I enclose a few of the crystals from spirit.

In my opinion there are several quite distinct products obtainable by treating phenol with sulphuric and oxalic acids; otherwise there is no reconciling the varied results got by different chemists. My results, at any rate, are quite opposed to MM. Prud'homme's views. I agree with them that it is not necessary to form phenyl-sulphuric acid, but I do not think the sulphuric acid acts merely as a dehydrator. It is not rosolic acid that is formed by the action of sublimed or dehydrated oxalic acid on phenol. My experiments also contradict the view that the carbonic acid of the oxalic has nothing to do with the reaction, and that it is entirely owing to carbonic oxide. I have obtained a rosolic acid in experiments in which there was substituted for the oxalic acid a substance yielding carbonic acid, but neither formic acid nor carbonic oxide: and I have endeavoured in vain to obtain it when substituting formic acid for the oxalic. I have also produced a rosolic acid from the usual ingredients, with an addition, *without any heating whatever*, and without evolution of carbonic acid.

As a crystalline ammonia compound has been described, I may mention that the finest thing of this kind I have got has been by injecting gaseous ammonia into a solution of the crystalline rosolic acid in acetone. Magnificent crystals are thus produced having a bright blue metallic lustre, which, however, soon disappears on the mother-liquor being filtered off.—I am, &c.,

Edmund Hunt.

Glasgow, May 19, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 5, 1873.

Heat Liberated in the Reaction Between Water, Ammonia, and the Alkaline Earths, Baryta, Strontia, and Lime; Constitution of Alkaline Solutions.—M. Berthelot.—Alkaline liquids do not contain the anhydrous alkalies in the state of simple solutions, nor even of alkaline monohydrates: but they contain in reality like the hydracids certain definite hydrates formed by the association of several molecules of water with 1 molecule of the alkaline hydrate. The existence of these dissolved hydrates is shown in the first place by the formation of crystalline hydrates, as that of potassa, KHO_2+4HO; of soda, $NaHO_2$, and $3HO$, and $7HO$; of baryta, $BaHO_2+9HO$; and of strontia, $SrHO_2+9HO$. Physical evidence supports the same views. Thus Wuellner recognised, in studying many salts, that the tension of the vapour of water given off by a saline solution experiences a decrease proportional to the weight of salt dissolved. The author has been led to the same conclusion by his thermic studies; the heat given off shows the existence and the formation of several successive hydrates in a solid or dissolved form. The same opinion is corroborated by the phenomena of the precipitation of salts of dehydration. The existence of alkaline hydrates, incompletely formed in concentrated liquids, and which are progressively completed by additions of water, explains, in the author's opinion, the reversal of certain reactions on concentration.

Distribution of Potassa and Soda in Plants.—E. Peligot.—The author has endeavoured to determine whether a plant, watered during the entire period of its growth with water holding in solution common salt and nitrate of soda, absorbs a certain quantity of soda; and whether it takes from the soil other elements from plants of the same species cultivated under identical circumstances, but watered—some with common water and others with potassic and magnesian solutions? The tabulated observations show that the common salt and the nitrate of soda have been totally left by the plants; none of the ashes contained soda. Nitrate of soda acts only in consequence of the acid it contains, which probably combine by double decomposition with potassa or lime.

Action of Ozone on Absolute Alcohol; Combination of Cyanogen with Hydrogen under the Influence of the Electric "Effluve."—M. A. Boillot.—When oxygen or air is passed into absolute alcohol after having traversed the "effluve" apparatus, acetic and formic acids are speedily formed. Acetic ether is also found among the products generated. There is also a white powder, which is deposited on the evaporation of the liquid in the air, and which is soluble in water and alcohol. The experiment on the action of the effluves on a mixture of cyanogen and hydrogen has been repeated, and a notable quantity of hydrocyanic acid has been obtained.

Purification of Hydrochloric Acid.—M. Ergel.—To a litre of the acid are added 4 or 5 grms. of hyposulphite of potassa dissolved in a little water. After a certain time the liquid turns yellow, then brown, and a precipitate is deposited. The acid is left to settle for forty-eight hours, and is then decanted and distilled almost to dryness. The smallest traces of arsenic and of free chlorine are thus removed.

Determination of Sugars by Barreswil's Method.—By M. E. Feltz.—The author has shown, in a former note, that the cupro-tartaric liquid cannot be used to determine glucose in presence of an excess of crystallisable sugar. The experiments were made on saccharine solutions containing only traces of glucose. The determination by means of a standard solution requires in this case a long time, and the reducing action of cane-sugar is thus increased. It might be thought that when operating upon mixtures richer in glucose the error would become insignificant: experiment proved that such was not the case. (I.) A saccharine solution, containing in 100 c.c. 10 grms. of crystalline sugar and 0·398 grm. of inverted sugar, was titrated with 10 c.c. of Vidette's liquid; 0·461 grm. of inverted sugar was found as result. (II.) Another saccharine solution, containing in 100 c.c. 15 grms. of crystalline sugar and 0·298 grm. of inverted sugar, gave 0·378 grm. of the latter. On repeating this latter analysis, adding the saccharine liquid by smaller doses, so as to prolong the process, the apparent quantity was raised to 0·425 grm. It is commonly admitted that cane-sugar is not modified by solutions of caustic soda. An analytical process has even been based on the different action of soda upon glucose and upon cane-sugar. Various experiments have proved that, in the conditions of alkalinity of the cupric liquid, soda reacts upon crystallisable sugar. The errors which may result from the use of Barreswil's method in determining the purity of saccharine products are very serious.

Statistic of the Volumes of Chemical Equivalents and Molecular Considerations.—By M. G. West.—A preliminary notice. The author's object is to ascend from the volumes of compound bodies to those of simple bodies, comparing such only as are of the same dilatability. The more dilatable are considered at low, and the less dilatable at high, temperatures. He is of opinion that by accumulating observations of this nature we may obtain, as regards the chemical and physical properties of bodies, conclusions as precise as those which astronomers obtain in the prevision of celestial phenomena. In equally expansive substances the volumes are commensurable; their common measures constitute the uniform volume of sub-molecules. The same simple body contains a number of sub-molecules, depending on its chemical character. In compounds various components are recognised, some possessing the properties of acids, others of bases, others the deoxidising property of aldehydes, and many being neutral. Compound elements possess always the same chemical property. In ternary organic chemistry the compound elements, to the number of a score, form thousands of substances by adding themselves to each other. The author proposes an explanation of the volumes of sub-molecules; then he explains the expansion of simple bodies in multiple volumes, and their contraction in sub-multiples. He makes use of the heterogeneous character of different portions of a compound molecule to show its electric polarity. By the aid of molecular polarity he explains—(1). The harmony of substitution with electro-chemistry, thus reconciling two conflicting chemical schools. (2). The phenomena of tension-electricity, without the hypothesis of electric fluids. (3). Electric conductibility. (4). The diphlogistication of metals. (5). The reciprocal actions of electrodes and their inductions, without the hypothesis of currents. (6). The reciprocal action between magnets, diamagnetic bodies, and electrodes, without assuming magnetic currents. By the aid of the atomic heat of bodies, and the vibrations of the "ether," the author thinks that he can explain the phenomena of gravitation.

Revue Scientifique de la France et de l'Etranger, No. 44, May 3, 1873.

This number contains no original chemical papers.

Bulletin de la Société Chimique de Paris, May 5, 1873.

Constitution of Hydracids in Solution, and on the Inverse Reactions which they Cause.—M. Berthelot.

Solidifying-Points of Mixtures of Water and of Acetic Acid.—M. E. Grimaux.—We shall endeavour to give this paper in full at an early opportunity.

Derivatives of the Tetrachloride of Naphthaline.—M. E. Grimaux.—Second memoir; this paper is also reserved for insertion.

Action of Chloride of Chloracetyl on Aniline and Toluidine.—M. C. Tommassi.—Aniline and toluidine, under the influence of monochlorated chloride of acetyl, give up an atom of hydrogen in exchange for an atom of chloride of acetyl, and give rise thus to two new crystalline products, phenyl-chloracetamide—

$$\left.\begin{matrix} C_6H_5 \\ H \\ C_2H_2ClO \end{matrix}\right\} N$$

and cresyl chloracetamide—

$$\left.\begin{matrix} C_7H_7 \\ H \\ C_2H_2ClO \end{matrix}\right\} N$$

These compounds are obtained by a procedure analogous to that directed by the author for the preparation of chloracetylurea (*Bull. de la Soc. Chim.*, tome xix., 243). The only precaution to be taken is to introduce the aniline or toluidine in small quantities at once into well cooled monochlorated chloride of acetyl; rather more than 1 molecule of which is employed to 1 of aniline or toluidine. Phenyl chloracetamide crystallises from its aqueous solution in fine needles. It is deposited from alcohol in mammillary tablets. It fuses at 97°, and sublimes at higher temperatures. Ether and acetic acid dissolve it freely. Sulphuric and hydrochloric acid dissolve it with the aid of heat. Boiling nitric acid converts it into a new substance not yet analysed. Phenyl chloracetamide gave on analysis the following results:—

	Calculated.	Found. I.	Found. II.
Carbon	50·73	50·11	50·08
Hydrogen	4·71	4·83	5·13
Chlorine	20·94	21·85	20·95
Nitrogen	8·26	8·01	8·42
Oxygen	15·36	—	—

Cresyl chloracetamide crystallises in prismatic needles which sublime at 110°, and melt at 162°. It is insoluble in boiling water. Sulphuric and acetic acids dissolve it slightly in the cold, but more freely when heated. It is insoluble in hydrochloric acid. Under the influence of nitric acid it is converted into a nitro compound. On analysis it gave—

	Calculated.	Found. I.	Found. II.
Carbon	58·85	58·83	59·07
Hydrogen	5·11	5·62	5·57
Chlorine	19·34	19·16	19·14
Nitrogen	7·62	7·33	7·31
Oxygen	8·75	—	—

Dyeing Aniline Green on Wool.—Ch. Lauth.—This dye, unlike the majority of aniline colours, has but a feeble affinity for wool. When this fibre is dyed in a green bath without previous preparation, but a very slight amount of the colour is fixed. Some manufacturers have proposed to employ for this colour the alkaline process, which gives such excellent results for blues, but is with greens less certainly successful. The author's process is to prepare the wool in a bath containing a solution of hyposulphite of soda mixed with an acid or an acid salt. The sulphur suspended in the water becomes fixed upon the wool, and enables it to attract the aniline green. It is advisable to add to the mordanting-bath a small quantity of alum, or of a salt of zinc, the presence of which prevents the "tendering" of the wool. It is singular to see the action which the sulphur of the hyposulphites exerts upon this fibre. It becomes soft, loses its elasticity, and contracts considerably. This depends evidently on the penetration into the capillary tubes of the wool of that soft and viscid sulphur which is liberated from the hyposulphites. The singular property which sulphur in this state possesses of acting as a mordant for aniline green is not common to sulphur in all its modifications. Thus the solution of flowers of sulphur in the sulphide of carbon leaves wool completely incapable of attracting the dye. The same rule holds good, though to a less extent, with the polysulphides, which in all probability generally contain traces of hyposulphite. The mordant for aniline green is the insoluble electro-positive sulphur, as proved by the following experiment. When a sample of wool mordanted with hyposulphite is exhausted with sulphide of carbon, it loses nothing of its power of attracting and fixing aniline green; whilst another portion of wool saturated with the bisulphide of carbon which has served to extract the former, and which has been subsequently concentrated by distillation, takes up the colour no better than does unprepared wool. If the operation is carefully conducted, taking suitable proportions of hyposulphite, and of alum, or zinc-salt and acid, success is certain, and the wool is uninjured. It is scarcely needful to add that the wool must be previously cleansed from grease, and freed from all metallic contaminations by passing it through very weak hydrochloric acid. If this is neglected the shade may be saddened by the formation of metallic sulphides upon the fibre. The actual dyeing is performed in a solution of the green in hot water, raising the temperature to close upon 100° C. If yellowish greens are desired it is necessary to add to the bath some picric acid, and a salt capable of raising this colouring matter, which will only dye in presence of an acid. As on the other part the green does not dye in presence of acids a difficulty presents itself. This is overcome by the use of the acetate of zinc. This salt attracts the picric acid without injuring the green dyeing. If it appears that the green does not "work on" sufficiently a little acetate of soda may be added. With the aid of these two salts the dyer can produce blue or yellow shades of green at his pleasure, and can make use of his bath for an indefinite length of time. This procedure applies equally well to mixed goods of wool and cotton. After the wool is mordanted as above, the pieces are washed in sumach for an hour or more. The dyeing is then conducted in the ordinary manner, beginning at a low temperature. Or the wool may be dyed first, and the goods may then be sumached, and the cotton dyed in a cold colour-bath.

American Journal of Science and Arts, April, 1873.

Comparison of the Mean Daily Range of the Magnetic Declination and the Number of Auroras Observed Each Year, with the Extent of the Black Spots on the Surface of the Sun.—Prof. Elias Loomis, of Yale College.—This inquiry is an extension of one previously made by the author, and has been suggested by the publication of a new and very complete catalogue of auroras, by Prof. Joseph Lovering. For the relative extent of spots on the solar surface, Prof. Loomis takes the numbers furnished in Dr. Woolf's latest publications, and for the magnetic declination, the numbers obtained at Prague, as given in the *Vierteljahreschrift* and the *Beotacklunger Zutrag*. Lovering's catalogue of auroras embraces over 12,000 cases, extending from 500 B.C. to 1864. In selecting the data, some discrimination was necessary. The author excludes all observations from high northern latitudes, because the reports from these are only occasional; and also many from some lower latitudes, furnishing tolerably continuous accounts, as there was reason for thinking (he had already shown) the inequality of displays in these, in different years, consists more in unequal *brilliancy* than in unequal *frequency* of exhibition. The line drawn, however, is not arbitrary, but one denoting *equal auroral frequency* (as formerly determined). It

passes near St. Petersburg, Stockholm, the boundary between England and Scotland, and, crossing the Atlantic, follows the northern boundary of Massachusetts. The eastern boundary selected is 40° east of Greenwich, and the western 80° west. Observations from the southern hemisphere, from Asia, and from the western portion of the United States, are excluded (not forming a long series). Every known auroral observation within the above limits from the year 1776, when the magnetic observations commenced, is employed, and Lovering's list is completed as far as possible to the end of 1872, and otherwise supplemented. The catalogue is given *in extenso*, and the following table gives the total number of auroras for each year. To eliminate the effects of irregular and non-periodic causes, the average of the numbers in the second column is taken for each successive period of three years, and the numbers thus resulting are given in the third column:—

Number of Auroras from 1776 *to* 1872.

Year.	Aurora.	Mean.	Year.	Aurora.	Mean.
1776	39	—	1825	8	5
1777	81	69	1826	6	14
1778	88	97	1827	27	20
1779	123	91	1828	26	29
1780	62	94	1829	34	46
1781	97	83	1830	77	54
1782	90	92	1831	52	50
1783	88	76	1832	22	36
1784	51	65	1833	34	28
1785	55	83	1834	27	26
1786	143	112	1835	17	27
1787	139	139	1836	36	36
1788	135	131	1837	56	46
1789	118	112	1838	47	55
1790	82	93	1839	63	61
1791	79	76	1840	74	73
1792	66	56	1841	81	69
1793	23	33	1842	53	57
1794	11	14	1843	36	41
1795	9	8	1844	34	39
1796	3	9	1845	48	50
1797	15	6	1846	69	58
1798	1	8	1847	58	78
1799	7	5	1848	108	83
1800	6	6	1849	82	104
1801	5	6	1850	122	104
1802	8	8	1851	109	115
1803	10	10	1852	114	99
1804	12	15	1853	74	75
1805	22	15	1854	36	42
1806	11	13	1855	17	22
1807	5	6	1856	13	14
1808	3	3	1857	12	24
1809	2	2	1858	47	40
1810	1	1	1859	62	55
1811	0	0	1860	57	57
1812	0	1	1861	51	49
1813	2	4	1862	39	40
1814	9	5	1863	30	35
1815	3	5	1864	37	39
1816	3	6	1865	51	39
1817	11	11	1866	30	30
1818	18	14	1867	9	20
1819	13	12	1868	20	41
1820	5	7	1869	95	82
1821	3	3	1870	130	117
1822	2	2	1871	125	126
1823	0	1	1872	122	—
1824	2	3			

The auroral curve obtained from these average numbers shows great irregularities in the number of auroral exhibitions, but affords unmistakable evidence of a periodic alternation of seasons of abundance with seasons of scarcity. On comparing this curve with the sun-spot curve there appears a correspondence which is remarkable, though not so close as that between the magnetic curve and the sun-spot curve. In the dates of minima it may be said there is complete identity; in the maxima there is some discordance, which in 1840 amounts to three years. The critical parts of the auroral curve occur a little later than those of the sun-spot curve, and the auroral maximum is often more prolonged than the sun-spot maximum. Comparing the auroral curve with the magnetic curve the correspondence is greater, while the time of auroral maximum either coincides with the magnetic maximum, or slightly precedes it, the average difference amounting to about half a year. Prof. Loomis considers the fact of a true periodicity in auroral phenomena to be clearly established. He supposes the disturbance of the sun's surface, when spots appear, to be accompanied by a direct flow of electricity from the sun, which, travelling through the void celestial space, developes no light, but as soon as it encounters the earth's atmosphere (which appears to extend to the height of about 500 miles) it developes light, and its movements are controlled by the earth's magnetic force in a manner analogous to the influence of an artificial magnet upon a current of electricity circulating round it.

Notices of Recent Earthquakes.—Prof. C. G. Rockwood.

On some Points in Dynamical Geology.—Dr. T. Sterry Hunt.—The writer states that since 1858 he has been labouring to expand, complete, and give geological and chemical consistency to the suggestion long since made by Keferstein, and by Sir John Herschel, that the deeply buried and water-impregnated strata between the superficial crust of the earth and the solid nucleus constitute "a plastic material adequate to explain all the phenomena hitherto ascribed to a fluid nucleus." He notices several points in a recent essay, by Prof. Leconte, on the earth's crust; and considers that, by the contributions of Voze and Mallet, the theory of volcanic action, on the basis just referred to, is now well nigh complete.

Simple Device for Projecting on a Screen the Deflection of the Needle of a Galvanometer.—Dr. Alfred M. Meyer.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 2, May 8, 1873.

Thermo Diffusion.—It appears to result from some experiments of Jedderson, published in *Pogg. Ann.*, that if a porous body is placed in the form of a diaphragm and exposed to differences of temperature on its two surfaces, a current of gas is set up from its cold to its hot side. The author considers this phenomenon as differing from ordinary diffusion, and proposes to distinguish it as "thermo diffusion."

Silica as Polishing Material.—M. Mignat, of Paris, proposes the use of hydrated silica in the state of impalpable powder instead of oxide of iron.

MISCELLANEOUS.

Public Analysts under the New Act of Parliament.—The practice of appointing medical men as Public Analysts, which is actually taking place, is beginning to bear grotesque fruit. For instance, the food analyst to one of the London Vestries has published his discovery that the caseine in unsophisticated cow's milk varies from 9·45 to 4·70 per cent, and in a sample of milk which was purchased he alleges that the solid contents of the milk amounted to 13·3 per cent, and that of these 8·4 consisted of caseine. The source of these wonderful discoveries will be obvious to chemists. It is ignorance of the fact that the fat is precipitated along with the caseine when milk is coagulated, and that in order to estimate the caseine correctly a thorough washing with ether is required. In the case of the 13·3 per cent of milk-solid

alleged to contain 8·4 of caseine, very nearly the entire fat must have been weighed with the caseine. This instance of official ignorance speaks volumes, and calls for the interference of the Government.

Soluble Glass in the Arts.—The employment of this substance in the arts is rapidly extending, and it has become indispensable in many industrial branches. It seems to be specially well adapted to the production of cements; when intimately mixed with fine chalk, it is found that a hard cement will be formed in from six to eight hours. With powdered sulphide of antimony, a black mass is produced, which is susceptible of taking a high polish, and possesses then a superb metallic lustre. Fine iron-dust gives a grey-black mass of great hardness. Zinc-dust gives a grey mass of much hardness, and having a metallic lustre. Zinc castings can be readily repaired by its aid.—*Journal of the Franklin Institute.*

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the production of colours for dyeing and printing. Edward Chambers Nicholson, Herne Hill, Surrey. October 19, 1872.—No. 3094. In the production of colours from aniline it is the general practice to employ what is known as arsenic acid, which when heated with aniline produces colouring matters which have as their base rosaniline. Now this invention relates to the substitution of arsenic acid in and for the production of colours from aniline of nitric acid and of hydrochloric acid, by the employment of which acids in conjunction with an excess of aniline and upon the application of a sufficient and prolonged heat, viz., of a temperature of about from 350 degrees to about 400 degrees Fahrenheit, to such mixture or combination, the desired colouring matters are produced. In carrying out my invention I take about 3 parts by weight of commercial aniline, such as is now generally employed for the production of red aniline dyes, and I add thereto about 1 part by weight of nitric acid of about the specific gravity 1420 and about 1 part by weight of hydrochloric acid of about the specific gravity 1160, the mixture or combination being contained in a boiler or other suitable vessel. I heat the same to a temperature of from about 350 degrees to about 400 degrees Fahrenheit until the conversion of the aniline and the compounds of aniline unto the desired colouring matters is effected, which result can be ascertained by occasionally testing the contents of the boiler. I have mentioned the temperature of about 350 degrees to about 400 degrees Fahrenheit as I find that the employment of such an elevated temperature is much more advantageous than the employment of a lower temperature, such for example as a temperature of 212 degrees Fahrenheit or the temperature of boiling water. Having effected the desired result, the contents of the boiler or other suitable vessel are removed and the colouring matters extracted therefrom by means of boiling water or other solvent, and the colouring matters thus separated may be either employed direct or may be subjected to purification, or the base, viz., rosaniline, may be separated therefrom by means of an alkali or of an alkaline earth as is well understood. I wish it to be understood that although I have given the proportions with which I have obtained good results I do not limit myself to such, as they may be modified.

Improvements in the treatment of substances capable of being employed for the purposes of dyeing and printing. Astley Paston Price, consulting chemist, 47, Lincoln's Inn Fields, Middlesex. October 19, 1872.—No. 3095. In the production of what is known as red aniline dyes from aniline, the method generally adopted is to heat together a mixture of aniline, or that substance which is known as commercial aniline and arsenic acid, until the desired colours are produced. The result thus obtained is known technically as the "melt," and the subsequent treatment or purification of the melt is generally conducted as follows:—The melt is digested in boiling water, and in some cases the solution is filtered and allowed to cool in order to separate what is known as arseniate of rosaniline and other compounds. The supernatant solution, or the original solution of the melt, is treated with lime in order to separate the arsenic and the arsenious acids which exist in the solution either in combination with rosaniline or with other colouring matters or otherwise. The liberated base, or what is known as rosaniline base, is then dissolved out by means of hot water, and is separated by crystallisation. By this process the arsenic and the arsenious acids are converted into arseniate and arsenite of lime, and thus rendered insoluble, and hitherto these products have been of no practical value. Now this invention relates to the treatment of the before mentioned product, or the result of heating aniline with arsenic acid and known as the "melt," in such a manner as that the arsenious and the arsenic acids contained in the solution of the melt shall be obtained in an available condition, and not as hitherto as a compound of lime possessing but little, if any, commercial value, and it consists in adding to the solution of the melt such an amount of ammonia or of ammoniacal liquor, as shall liberate the rosaniline base existing in such solution in the form of arseniate or arsenite of rosaniline. After allowing the base thus liberated to separate from the solution, the said solution contained in a suitable distillatory apparatus is submitted to the action of heat, either by applying heat externally or internally, or by the injection of a jet of steam, or otherwise. The compound of arsenious acid and ammonia is thus decomposed, and ammonia is liberated, which after having been collected may be again employed or otherwise utilised. The arsenious acid remaining in the solution may be separated therefrom by evaporation and crystallisation, or otherwise. In this manner the arsenious acid may be recovered in a condition capable of being re-converted into arsenic acid as is well understood. Any arsenic acid which had not been previously separated by crystallisation, as arseniate of rosaniline, will be found to be contained in the residual solution after having effected the decomposition of the solution of arsenite of ammonia by the employment of heat, and such arsenic acid or arseniate of ammonia may be separated either by evaporation or by evaporation and crystallisation.

Improved processes and apparatus for manufacturing compounds of pyroxyline or gun-cotton. William Robert Lake, patent agent, Southampton Buildings, London. (A communication from John W. Hyatt and J. Smith Hyatt, Albany, New York, United States of America). October 21, 1872.—No. 3101. This invention relates to the conversion and manufacture of pyroxyline or soluble cotton into a solid (which is herein denominated "celluloid") in accordance with a general process described in the Specification of Letters Patent, dated April 18th, 1871, No. 1025, to which Letters Patent reference is here made for a full description of the said process. This invention consists in the method or process of drying the prepared mixture of soluble cotton and camphor gum. In the process of manufacturing celluloid. In the process of dissolving or transforming pyroxyline. In the arrangement of a cold water jacket around the upper portion or receiving end of the heated converting cylinder. In the combination with a converting cylinder provided with a cold water jacket of a steam or hot water jacket. In the arrangement with the cold water jacket of the escape pipe of the hydraulic engine. In the arrangement with the upwardly projecting piston rod of the hydraulic engine and the supply and escape pipes thereof of two three-way cocks. In the arrangement in the discharge end of the converting cylinder of a central heating and distributing core; and in the combination with the hydraulic engine, converting cylinder, and celluloid discharge pipe of a mould and hydraulic clamp.

NOTES AND QUERIES.

Lard Oil.—Could you kindly inform me how to prepare lard oil? I have some few hundredweights of rancid lard I want to convert into oil.—J. Wood.

Removing Stains from Paper.—Could any of your subscribers inform me how I can clean prints and engravings; also how can I remove the foxed or reddish-brown marks occasionally seen on some plates and paper.—Subscriber.

MEETINGS FOR THE WEEK.

Monday, 26th.—Geographical, 1 p.m. Anniversary.
Tuesday, 27th.—Royal Institution, 3. Mr. J. H. Parker, "On the Archæology of Rome."
—— Civil Engineers, 8.
Wednesday, 28th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 29th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Royal, 8.30.
—— Philosophical Club, 6.
Friday, 30th.—Royal Institution, 9. The Earl of Rosse, D.C.L., F.R.S., M.R.I., "On the Radiation of Heat from the Moon, the Law of its Absorption by our Atmosphere, and its Variation in Amount with her Phases.."
Saturday, 31st.—Royal Institution, 3. Mr. J. Morley, "On the Historical Method."

TO CORRESPONDENTS.

W. Ripley Nichols.—The copies have been received, and one forwarded to Prof. Wanklyn.

R. Riley.—It is published weekly; S. Low and Co., Crown Buildings, Fleet Street, will procure it for you.

Goldsmith.—Pure hydrochloric acid will answer the purpose.

G. Procter.—The work is still in the press.

J. E. K.—See Chemical News, vol. xxv., pp. 166, 178, 242.

J. S. W.—There is no later edition of the work you mention; it is the best book you can have on the subject. A work on dyeing will shortly be published, which will also be useful to you.

THE CHEMICAL NEWS.

VOL. XXVII. No. 705.

ON A NEW MODE OF FILTRATION.

By ISAAC B. COOKE.

THE method of filtering, in which Bunsen has availed himself of Sprengel's water-air pump, is doubtless a great improvement upon the simple paper system: both in the time saved, and in the state in which the precipitate is left. But the pump is a comparatively costly apparatus, and not always suited to the position and circumstances of a private laboratory; and as the same, or nearly the same, effects can be produced by means which are in every chemists' hands, the plan here proposed may be convenient for some.

The needs of chemists have caused the manufacture of a special paper fitted for most of their filtering operations. But in some cases the texture is too coarse, and in some too fine. When a large sized filter is used the ash is too uncertain, and too great for nice quantitative operations. A small size requires constant and long-continued attention in order to pass through it even a reasonably small quantity of filtrate, together with the requisite washings.

In the process here advocated a quantity of carded cotton-wool, so small that the ash does not weigh 100 grs., and in commercial analyses may therefore be generally neglected, will suffice for any ordinary filtration; and a little experience enables the operator, by tight or loose packing, to adopt it to the coarsest or finest precipitate.

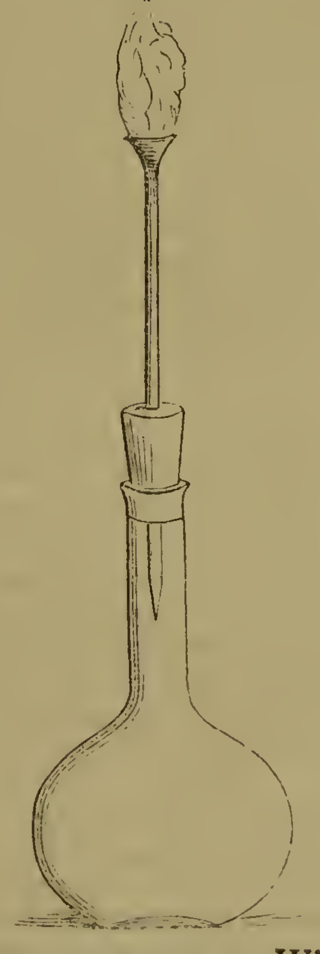
A glass flask, of not more than about 300 c.c. content, is fitted with a rubber stopper of soft and smooth surface, and of conical shape, so that the small end easily enters the neck of the flask; but the larger end cannot be forced in even under considerable pressure. Through the centre of the stopper a hole is bored to admit of a glass tube of about $\frac{3}{16}$ths inch internal diameter. The tube to be inserted should be about 6 inches long; one end being fused to a very small opening, and the other slightly enlarged in funnel form. About 1 inch of the nearly closed end of the tube is passed through the stopper, fitting tightly; and if an inch traverse the stopper 4 inches will be left outside when the stopper is in its place. Into the funnel-shaped mouth of the tube a small quantity of the carded cotton-wool is packed with the tapering end of a wire not having too sharp a point. The cotton-wool should be lightly pressed in at first until it occupies a length of about $\frac{1}{2}$ to $\frac{3}{4}$ inch of the tube, and then may be pressed more tightly at the mouth according to the quality of the precipitate to be filtered off, leaving a spreading brush of about $\frac{3}{4}$ inch length projecting from the end.

To put the instrument into operation a small quantity of distilled water is poured into the flask sufficient, but not more than sufficient, to quite cover the inner convexity of the bottom. The flask is then placed over the lamp till the water boils freely, and all air is expelled from the flask by steam. During the boiling the stopper should be placed in an inclined position, the short end of the tube resting against the inside of the neck of the flask, so as partially to close it, but leave space for the air and steam to rush out. Unless the mouth of the flask is thus partially closed during the boiling a much longer time is required to drive out the air; as if quite open a circulation takes place, cold air passing in at one side as steam is driven out at the other.

When steam issues freely past the sides of the stopper the flask may be taken from the lamp, and the stopper immediately pressed into its place and kept there by pressure until condensation begins. The flask is meantime inverted, and the tube with its brush of cotton-wool plunged into the fluid to be filtered, taking care that the wool is wholly submerged; as if any portion be left dry protruding from the fluid air will be drawn through it into the flask. As soon as the fluid is seen to be rising up the tube, the apparatus may be reared against a corner and left to itself.

The filtration will proceed with more or less rapidity in proportion as the cotton is packed lightly or solidly into the tube. When all the liquid has been drawn up, and the air is about to follow, a stream of distilled water from the wash-bottle may be driven upon the precipitate to wash it; and as the last portion of this also passes up the washing can be repeated, and again as often as is thought necessary. Lastly, the air following will leave the precipitate and the cotton-wool in a condition almost dry. The contracted orifice of the inner end of the tube secures it also free from fluid.

It is generally advantageous to perform the filtration from a small porcelain evaporating basin of about $2\frac{1}{2}$ inches diameter, supported on a cork ring. The fluid and precipitate can be gradually poured and washed into



the basin as the process goes on. When it is completed the flask may be reverted, the stopper gently loosened, and the inner end washed by a stream from the wash-bottle into the flask. The cotton plug must now be carefully taken out by forceps over the evaporating basin, partially wiping the end of the tube in doing so with the clean portion of the plug, and the whole added to the precipitate. The forceps should be carefully wiped with a very small piece of cotton-wool, which may be further used with the forceps to complete the cleaning of the tube, and then also added to the precipitate. The basin after being rapidly dried over the lamp is ready for ignition. The precipitate cannot well be separated from the plug without loss; but there are few cases in which it will be injured by being ignited with the small quantity of cotton of which the plug consists, or, at least, in which that injury cannot be remedied by re-ignition after treatment with nitric or sulphuric acid. On cooling, the basin and its contents can be weighed, and, after brushing out the ash, the basin alone; the difference of course being the weight of the ignited ash.

A flask of 100 to 150 c.c. capacity is usually sufficient for a filtration; but it is not safe to use one larger than 300 c.c. unless it be of a spherical shape without the flat or concave bottom, as larger ones are not always proof

against the pressure. A spherical flask would be better also in respect of requiring a smaller quantity of water to drive out the air, and, therefore, also a shorter time to prepare it. In this case, however, if only a small part of the surface of the bottom is covered with fluid, care is required not to crack the flask during the boiling.

If the stopper be pliable, smooth, and well fitting, no air will pass between it and the neck of the flask during the operation. But the appearance of such leakage is stimulated by the renewed boiling of the fluid in the flask in consequence of the diminished pressure. Unless the fluid to be filtered has been boiled immediately preceding bubbles of air will constantly ascend the tube during the process. Yet the vacuum caused by the initial boiling will be so nearly completed that the filtration and washing may be continued if necessary till the body of the flask is nearly filled with fluid, and on reversion only a portion of the neck will be occupied with air.

When a flask is found unexpectedly not to be large enough to contain all the fluid required by the washing, it is better to suspend the filtration before the flask is full, and raising it out of the fluid to allow air to pass up the tube before reverting. The plug will then be in a dry state, and no portion of the fluid will run down the outside of the tube and be lost. Another flask in which the same stopper fits may be prepared by boiling, the tube inserted, and the filtration completed.

ON SOME IMPROVEMENTS IN THE MODE OF ESTIMATING AMMONIA BY THE "NESSLER" TEST.

By SIDNEY HARVEY.

The wonderful delicacy of the Nessler test when used for the detection and estimation of traces of ammonia seems to deserve a more exact method than that usually adopted, viz., the comparison of the depth of colour produced by this reagent in solutions of known and unknown strength in *glass cylinders* filled to a certain height.

Having been much engaged for some time past in the estimation of ammonia in waters, I have devised the following simple apparatus for its more exact and speedy accomplishment, and which answers its purpose remarkably well.

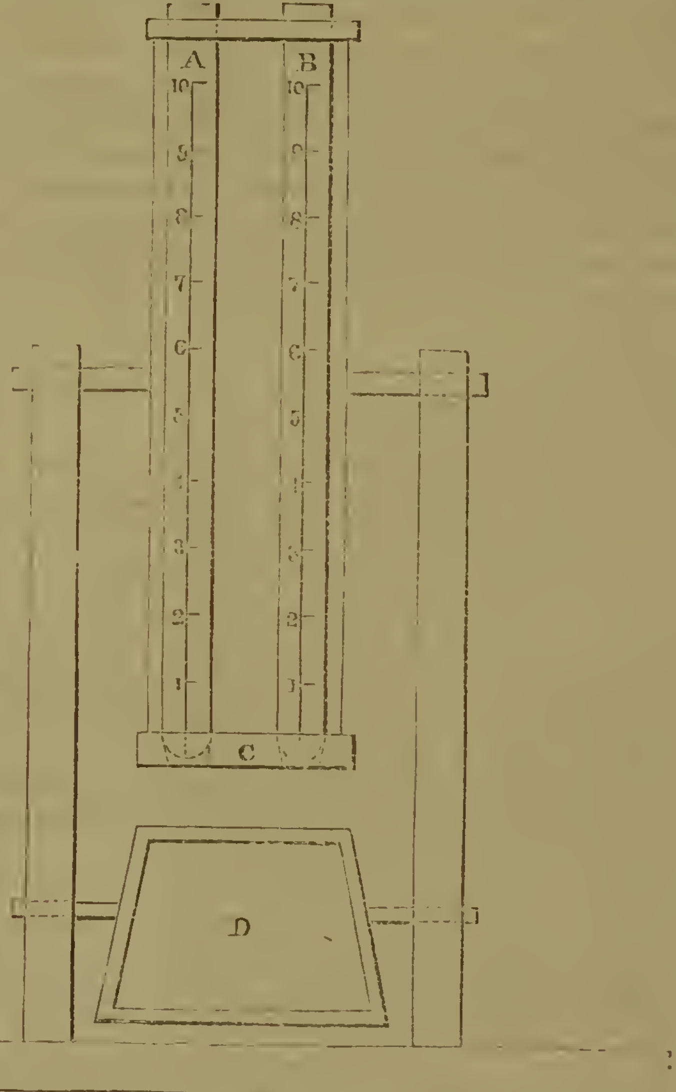
Two white glass tubes like test-tubes, but longer and of stouter glass, about ¾ inch internal diameter, and between 11 and 12 inches in length, are mounted upon a stand as shown in the sketch, and by means of pivots can be fixed either in a vertical position or swung to any convenient angle. These tubes are each divided by a paper scale or otherwise into inches in length, reckoning from the bottom, being graduated to contain 10 inches depth of fluid; they should also be marked respectively A and B. The cross-bar, C, should be perforated with two holes to admit the lower ends of the tube, which latter should be parallel, and not more than 1½ inches apart, reckoning from centre to centre. The holes should pierce the bar, and be contracted to ½-inch diameter at bottom. The under surface of the bar should be blackened; and below it in a convenient position should be fixed a small plate-glass mirror (D) about 5×3 inches, also swinging upon pivots.

To use this apparatus I proceed thus, dispensing altogether with the cylinders and stirring-rods:—I provide two stoppered flasks, each holding about 200 c.c., and marked respectively A and B. Into flask A I deliver a measured quantity, say 100 c.c. of the distillate (containing an unknown quantity of ammonia), add a proper quantity of Nessler test and shake. A trial solution, made by diluting a known number of c.c. of "standard" ammonia with pure water to exactly 100 c.c. also, is next introduced in flask B, Nessler added, and the mixture shaken. The apparatus, with the tubes in a vertical position, is placed near a window; the tubes filled up to the 10-inch mark with the solutions from the *respective* flasks, and then inclined towards the light at such an angle that by adjusting the mirror the operator looking close down upon the latter can see most clearly the reflection of the disc of colour. Should these discs agree in tint, the operation is over, and the estimation can be arrived at; but this is far from likely to be the result of a first trial, and here the use of the apparatus will be apparent. The column of *deepest* tinted liquid must now be *lowered* by returning it to its proper flask until the tints of colour as seen in the mirror exactly agree, and this can be done to the greatest nicety. The tubes are now replaced in a vertical position, and the height of the columns of liquid read off.

Now putting a for the height in inches of liquid in tube A,
and b ,, ,, ,, ,, ,, B,
also c ,, number of c.c. of standard NH_3 used in making the trial solution in flask B. The quantity of the latter in c.c. which *should* be used for the *next* trial solution is manifestly expressed by the formula—

$$C+\frac{b}{a}$$

The contents of tube and flask B may now be thrown out, and a second trial solution made in accordance with this



formula introduced into flask B, tested with Nessler, shaken, and tube B filled therewith as before. The discs of colour will now be found to agree very closely; so much so as to render a third operation needless, except in very precise investigations, when another adjustment can be made as before, and the new formula so obtained used for a fresh assay. The whole operation, after a little practice, will be found shorter and more certain than when cylinders are used, and is capable of a higher degree of accuracy.

A few words respecting the precautions to be observed when using the Nessler test may not be out of place. The quantity of "test" employed should be uniform. It should always be added *last*. No subsequent dilution of such mixtures with pure water should be allowed. Hence a liquid suspected to contain a comparatively large amount ammonia should be diluted to a known bulk previously

and a measured portion taken for testing. Solutions of too deep a colour are not so well compared as those of lighter tint: hence a limit to the length of the tubes employed, and which I do not think could be increased with advantage.

A very important question remains—How long after testing should the liquids "stand" before comparing colours? Messrs. Wanklyn and Chapman's invaluable little work upon "Water Analysis" recommends *ten minutes*. I do not find this time anything like sufficient; true, the *distilled* liquid containing NH_3 in the *free* state very soon comes up to full tint of colour after testing. Not so the *trial* mixture; very numerous experiments upon this point have convinced me that this latter is often half-an-hour, or little less in attaining its maximum of colour, and, therefore, comparisons drawn before this occurs would lead to too high results. I attribute this difference of time to the fact that the ammonia in the latter case exists as sulphate or hydrochlorate; and, moreover, in so dilute a state that even the large quantity of free alkali in the Nessler test does not liberate it fast enough. I have sought to remedy this when making a stock of "standard" chloride of ammonium by adding a portion of free KHO just before making up to exact measure, with, however, but partial success. As the problem for solution is the estimation of the ammonia which *really quits* the surface of the liquid in the retort used in the distillation, rather than that (however slight the loss) which ultimately reaches the receiving flask after condensation, it is a question whether the standard solution should not undergo the same ordeal by being distilled with alkali up to its exact original measure, and then *counted* to have lost nothing of its strength in the process. Trial solutions made with this latter would then contain NH_3 in the same state as it exists in that with which they are to be compared, and when tested would react as quickly with Nessler.

Canterbury, April 30, 1873.

ON THE CONDENSED EFFLUVE OF THE INDUCTION DISCHARGE.*

By M. Th. Du MONCEL.

The attention of chemists having lately been attracted to the effects produced by the condensed effluve of the induction discharge, I have thought it might be useful to communicate some facts connected with this physical phenomenon; the more so that some persons seem to confound the effects in question with those from the spark itself.

The electrical phenomenon to which I have given the above name is a sort of luminous discharge produced between two plates of glass, when these plates constitute together the insulating part of a condenser, the armatures of which are connected with the poles of a Rhumkorff apparatus. Thus, let one plate of window glass be separated from another by an interval of 2 or 3 millimetres; apply to their exteriors sheets of tin, or layers of liquid connected with the poles of the induced current, and you will obtain between the two insulating surfaces the electric effluve, which appears in the dark like a luminous rain, of bluish colour, and gives off ozone.

To obtain the phenomenon distinctly, the layer of air should be thoroughly dry; otherwise the discharge, instead of furnishing a homogeneous effluve, is concentrated in a small number of sparks of violet colour, which have not the properties of the effluve, properly so called; one of the most important of these being, that the discharge is finely divided over a large surface, and does not produce a heating effect nor sudden mechanical and disaggregating action. In virtue of this property one may electrise a gaseous body throughout its entire mass, avoiding the complex reactions which arise from the calorific and mechanical effects of the spark. And as the discharge takes place between two unattackable surfaces, we may obtain electro-chemical reaction without oxidations or volatilisations, or accidental absorptions capable of altering the nature of the products. By employing liquid layers as armatures, it is even possible (as M. Thenard has done) to follow by sight the effects successively produced.

At the time that I first made known to physicists this curious property of the induction discharge, of traversing glass without breaking it or illuminating the interior, some surprise may have been excited at such an electrical manifestation. But now that the numerous researches in England on the electric condensation produced in submarine cables have cleared up the question of electrical transmission through various bodies, there is no longer cause for this surprise. The phenomenon is explained by conceiving that, under the influence of condensation, the molecules of the insulating body become polarised after the manner of liquid molecules in electrolysis; so that they all conduce, individually and separately, to conducting the discharge from one surface to another of the glass plates. This is what the English have called *electrification*, and it is complicated by a momentary absorption of part of the charge; this absorption varying with the electrostatic capacity of the insulator. This subject is already well known, and I will only say here that it results from the mode of electrical transmission, and the insulating nature of the surfaces thus electrised, that the electrical charges not being capable of displacement from one point to another to take at the moment of discharge the path of least resistance, as in the case of metallic surfaces, the discharge cannot be concentrated in lines of air, but is forced to continue divided, except in the case in which the air-layer between the insulating surfaces is humid, when, these surfaces becoming conductive, the experiment is similarly conditioned to that of a discharge between two metallic surfaces.

The condensed effluve of induction may, in certain circumstances, present the curious aspect of stratified light (so well marked when the induction spark passes *in vacuo*). To obtain this, one of the plates should be slightly inclined upon the other, forming an acute angle. If one of the armatures is formed by a water-layer, kept in position by a border of mastic, the stratifications may be distinctly perceived; and they are made to disappear when the plates are restored to the parallel position. These stratifications are also observed when the space occupied by the effluve is broad and free of air.

The intensity of the electric effluve depends on the relative dimensions of the armatures and their polarity. It is a maximum when the smaller of the two armatures is positive. There is then seen about this armature a beautiful luminous radiation, and if the armature is cut so as to represent a silhouette, it stands out as a Chinese shadow on a luminous ground.

I will not dwell on the physical effects of the effluve, as these have been described at length in my notice on the Rhumkorff apparatus; but will simply point out that from an electro-chemical point of view, it may result from the difference of temperature between the effluve and the spark, that under certain conditions the one will act in the opposite direction to the other. Thus, from M. Jean's experiments, it seems demonstrated that ozone is only produced easily in atmospheric air at a low temperature, while at a high temperature the electrisation of the air causes the combination of its two constituent elements, a fact put beyond doubt by the experiments of M. Ed. Becquerel. It results, that according as we cause the effluve or the spark to act on an enclosed layer of air, we obtain ozone or hyponitric acid; and, in certain conditions, this difference of action may produce a combination or a decomposition. In the case of the spark traversing enclosed air, as in M. Becquerel's experiment, a combination is

* Abstract from *Comptes Rendus*.

obtained; but, on making the effluve react upon carbonic acid, as M. Jean did, this acid is decomposed into ozonized oxygen and carbonic oxide. In other cases the effects produced might be inverse, especially where the presence of ozone is necessary to determine a combination, as in a remarkable experiment by M. Thenard.

The foregoing facts prove clearly, then, that the mode of electrisation by the effluve is not at all the same as that produced by the spark.

The electric effluve has formed the subject of several important works, by MM. Grove, Thenard, Houzeau, Jean, Boillot, &c. I will here give some details (because they appear to have been forgotten) of certain curious experiments made by Mr. Grove, who, in 1856, succeeded in producing instantly, by means of the effluve on plates of glass, images similar to those of Moser. He placed between two glass plates, used for producing the effluve, a sheet of paper on which something was written, *Volta*, *e.g.*; under the influence of the effluve, the parts of the glass surface in contact with the lines of writing being impressed in a different manner from the other parts, it was sufficient on taking up the plate to breathe on its surface, in order to render visible an image of the writing; and by exposing to the vapours of hydrofluoric acid, an engraving on the glass was obtained.

For employing the effluve in electro-chemical experiments, two methods have been adopted. One consists in cementing together the two plates by their edges, allowing two tubulures for the entrance and exit of the gas: the other, in making the condenser with three tubes introduced one within the other, and so arranged that two of them enclose an annular liquid armature, surrounding at a distance of 2 or 3 millimetres the third tube, which contains the second armature. The former system has been employed by M. Jean, in his researches on ozone and carbonic acid; the latter, designed by M. Thenard, is the more perfect and practicable. The use of armatures of colourless liquid, besides affording facilities in watching the progress of the phenomenon, obviates the disruptive discharge which always occur with solid armatures at their contact with the glass, and which hinder the regularity of production of the effluve. These discharges are distinguished in the form of luminous lines, when one looks in the direction of the edge of the glass plates in this kind of condenser. In M. Boillot's apparatus, the armatures are of pulverised carbon, but I question if this acts so well as the liquid armatures.

ON GRAPHITE.

By J. STINGL.

To prepare graphitic acids the graphite employed must be freed from its ash constituents, for which purpose it is ground very fine, and treated with alkali at the point of fusion, aqua-regia, and hydrofluoric acid. The graphite of Ceylon is very difficult to purify. After being twice treated as above, there remained 0·42 per cent of an incombustible residue. A third operation reduced this to 0·12. Bohemian and Styrian graphite, purified as indicated, yielded mere imponderable traces of white incombustible matter.

Graphitic acid prepared according to the methods of Brodie and Gottschalk, from elutriated and purified Styrian graphite, is a fine yellow amorphous powder. Graphitic acid prepared from Ceylon graphite, from the so-called "Flintze" of the passan graphite, and from the graphite which separates out from crude soda-lye, appears, when examined under the microscope, to consist of foliaceous crystals. The graphitic acid from the Bohemian and Styrian graphite, when decomposed by heat, yields a black mass of great colouring- and covering-power, exceeding that of the finest lamp-black. The residue from the graphitic acid obtained from the foliaceous graphites does not colour, and has no covering-power. The division of graphites into amorphous and foliaceous is therefore of great practical importance. When a lubricating or covering body is required, as in anti-friction compounds, in domestic black-leads, &c., the Bohemian, Styrian, and Austrian graphites are preferable. But for the manufacture of crucibles for metallurgical purposes the foliaceous graphite of Ceylon has the advantage.

In the determination of the carbon in graphite, the author recommends the procedure employed in organic analysis. If determined as loss after ignition the result is too high, if carbonate of lime, sulphide of iron, and hydrated oxide of iron.

MISCELLANEOUS.

Poisoning Case at Blackburn.—John Thomas Hall, chemist and druggist, of Church Street, Blackburn, has been summoned before the borough magistrates of that town on three charges:—Firstly, with having, on the 25th of January last, sold to Mary McGrath a cough-mixture composed of opium and adulterated with hydrochloric acid; secondly, with having, on the 10th of February last, sold to Superintendent Eastwood a cough mixture adulterated with hydrochloric acid; and thirdly, with having sold, on the same day, to Superintendent Eastwood half-a-pint of vinegar containing hydrochloric acid. Chief-Constable Potts stated that in February last a child named McGrath, eight weeks old, was poisoned by an overdose of cough mixture containing laudanum purchased of the defendant. The defendant denied all knowledge of the vinegar containing hydrochloric acid, and said he had bought it for pure malt vinegar from the Cambrian Vinegar Company, Leeds. At the assizes the grand jury expressed a hope, in which the judge concurred, that an investigation would be made as to where the vinegar was adulterated, and by whom. Chief Constable Potts afterwards visited Leeds, and procured various samples of vinegar in course of manufacture from the Cambrian Vinegar Company, other samples of vinegar supplied by the Company to retail dealers, and a sample from the defendant himself of the vinegar supplied to him by the Company before the poisoning case occurred. All these samples were submitted to Professor Farley, of Leeds, and to Professor Railton, of Blackburn, for analysis, and they found all the samples free from hydrochloric acid or other deleterious ingredients. Evidence having been given corroborative of these facts, the Mayor, in imposing a fine of £5 and costs upon the defendant, said that the Cambrian Vinegar Company were exonerated from all blame.

Paper in the Boston Fire.—Curious results followed some of the experiments made upon charred papers and documents, and the examination of books in safes which proved worthless in the great fire. It was found that what paper makers call poor paper, paper considerably "clayed," stood the test best. Parchment paper, used for bonds and legal documents, shrivelled up exceedingly, and the print blistered so that it could be read when writing was illegible. So it was with the engraved work on notes. The gilding on the account books burned and charred showed out as bright and as clear as when the books were new, which brings up the question if to introduce gilt-edged account books would not be well, on the ground that the gilt would stay the passage of fire to the pages within. Books crammed into a safe so that it was difficult to get them out, suffered considerably less than those that were set in loosely, and in some cases came out from safes, in which everything else was worthless, so far preserved that the figures on their pages could be deciphered. With charred papers, which could not be made transparent by any light whatever used, it was found, after the employ-

ment of vitriol, oxalic acid, chalk, glycerine, and other things, that anything that moistened them to a certain stage—to which it was delicate work to get and not to pass—made the lines, words, and figures legible through a magnifying glass. It has been the almost universal experience that lead pencil marks show out all right where ink marks cannot be distinguished. The success of the use of photography has already been noted.—*Boston Advertiser*.

A New Experiment.—Mr. Elihu Thompson has made the observation that tin-foil, if wrapped about a few crystals of chlorate of potassa, can be made to detonate loudly upon being struck smartly with a hammer upon an anvil, or in a mortar. The phenomenon being precisely analogous to the well-known experiment of triturating sulphur and the chlorate. To the best of our knowledge the observation that such metals as tin can be oxidised in this way is a new one and worthy of notice.—*Journal of the Franklin Institute*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Annalen der Chemie und Pharmacie, band clxvii., heft 1, May 6, 1873.

On the Air contained in Sea-Water.—Oscar Jacobsen.—An interesting, but lengthy paper. The proportion of carbonic acid appears to be very variable, and at great depths, *e.g.*, 2000 fathoms, may exceed 30 per cent. Its amount seems connected with that of the saline matter. It cannot be considered as a free absorbed gas, like the oxygen and nitrogen, and can only be very imperfectly expelled by ebullition continued for an hour. An elaborate table is appended, showing the depth, the temperature, the percentage of saline matter, the amount of carbonic acid by weight and volume in a litre of water, and the respective proportions of the oxygen and nitrogen.

Oxidation of Allantoin by means of Ferricyanide of Potassium.—F. C. E. van Embden.—Some time ago, Mulder attempted to determine more closely the nature and formation of the lantanuric acid described by Schliesser. The view that this acid, along with urea, is formed from allantoin by combination with water is doubtful. He therefore attempted to obtain lantanuric acid by acting upon allantoin with ferricyanide of potassium and caustic potassa. A body distinct from Schliesser's lantanuric acid was the result. The author has made an examination of this substance. 4 grms. of allantoin were dissolved in potassa of sp. gr. 1·1, and ferricyanide gradually added. The colour produced on each addition disappears rapidly at first, but subsequently more slowly. More alkali was added from time to time. Ammonia escaped. The crystalline deposit of ferrocyanide formed was re-dissolved by the addition of a little water. When the colour ceased to disappear (which required about 16 grms. of ferricyanide), the liquid was slightly acidulated with acetic acid; the crystalline precipitate was filtered off, pressed, digested with a little water, and pressed again. It forms then a white mass which, by re-crystallisation, can be obtained in white, silky needles. The aqueous solution has an acid reaction. Neutral acetate of lead throws down a heavy white precipitate, gelatinous at first, but subsequently crystalline, soluble in excess of the precipitant, but re-precipitated on the addition of ammonia. Basic acetate of lead gives a similar precipitate, likewise soluble in the neutral acetate. Nitrate of silver yields a white precipitate easily soluble in acetic acid and in ammonia. Baryta-water gives a white gelatinous precipitate, insoluble in hot or cold water, but easily soluble in acetic acid. On desiccation at 100° C., or over sulphuric acid, there was no loss of crystalline water. The composition of these crystals is—

Carbon	24·40
Hydrogen	1·02
Nitrogen	21·40
Potassium	20·07

corresponding to the formula $C_4N_3H_2KO_4$. It may be regarded as the acid potash-salt of an acid $C_4N_3H_3O_4$, which the author proposes to name "allantoxanic acid." The same acid can be formed by the oxidation of allantoic acid ($C_4N_4H_8O_4$) in a similar manner. Its production can be represented by the formula—

$$C_4N_4H_6O_3+O=C_4N_3H_3O_4+NH_3.$$

Action of Sodium-Amalgam upon Dinitro-Hephthylic Acid.—H. A. Kullhem.—The author obtained dinitro-hephthylic acid by the prolonged action of nitric acid upon camphor. He has now exposed this acid to the action of nascent hydrogen, and obtained a new mono-nitro acid. The new acid dissolves easily in water, alcohol, and ether; it fuses at 115° to 116° C., and is volatilised below 100° C. Its composition is—

Carbon	44·72
Hydrogen	6·83
Nitrogen	8·70
Oxygen	39·75
	100·00

corresponding to the formula $C_6H_{11}(NO_2)O_2$.

Products resulting from the Decomposition of Glyceric Acid by Chloric Acid.—MM. Werigo and Okulitsch.—This paper does not admit of abstraction.

History of the "Sprengel Water-Pump."—H. Sprengel.—A short controversial note.

A New Acid Obtained from Aloes.—P. Weselsky.—Aloes, according to Hlasiwetz, yield, when oxidised by fusion with caustic potassa, para-oxybenzoic acid and orcin as main products. When, however, large quantities of aloes are used (*e.g.*, 20 lbs.), it is possible to isolate a third product: this is an acid hitherto unknown, closely connected with orcin, and further interesting on account of its isomerism with certain well-known acids. It is distinctly crystalline, and affords highly characteristic reactions. It was obtained as follows:—The aloes, socotrine, were melted in a roomy iron pan, in quantities of 2 lbs. at a time, with 3 parts of crude caustic soda till the phenomena indicated by Hlasiwetz made their appearance. The solution of the various melts was acidified with dilute sulphuric acid, filtered, and agitated with ether. After the ether had been shaken off, and the bulk of the para-oxybenzoic acid had been removed by crystallisation from the residue after evaporation to the consistence of a thin syrup, the mother-liquor, still containing orcin, the residue of the para-oxybenzoic acid, the new acid, much acetic acid and tinctorial products of decomposition, was dissolved in water and mixed with acetate of lead. The precipitate which falls contains chiefly the last-mentioned bodies. It is removed, and the filtrate is freed from lead by means of sulphuretted hydrogen. Hereon the acid liquid is saturated with carbonate of baryta, in order to separate the orcin from the acids. After this treatment the liquid is

again agitated with ether, and the orcin is obtained from the ethereal extract. The aqueous barytiferous liquid is now mixed with dilute sulphurous acid, the sulphate of baryta is filtered off, and the filtrate again agitated with ether. After the ether has been expelled the bulk of the remaining para-oxybenzoic acid crystallises out of the residue. The strongly acetic mother-liquors (A) congeal on standing to a granular crystalline paste, which, when pressed and re-crystallised from hot water, yield fine round verruciform crystalline groups, consisting of minute radiating needles. After bleaching with animal charcoal, the substance becomes colourless, and its crystalline form has a strong resemblance to that of gallic acid. This substance is the new acid; the whole yield did not exceed 30 grms. The analysis of the substance dried at 100° C. leads to the formula $C_9H_{10}O_3$. The acid is capable of distillation, when a faintly coloured oil is obtained, which soon congeals in crystals. The anhydrous acid, $C_{18}H_{18}O_5$, dissolves slowly in boiling water, and is gradually re-converted into the hydrous acid, $C_9H_{10}O_3,H_2O$. This change is more rapid in presence of alkaline carbonates. The formula $C_9H_{10}O_3$ corresponds to eight known acids—the melilotic, hydroparacumaric, phenyl-lactic, xyletinic, oxymesitylenic, phloretinic, isophloretinic, and tropasic. It is, however, not identical with any of these acids, as its properties show. It is sparingly soluble in cold, but completely in boiling, water, and crystallises out, on cooling, in long voluminous needles concentrically grouped. Its taste is faintly acid and slightly astringent. In ether and alcohol it dissolves readily. The melting-point of the air-dried acid is about 97° C., but, when dried over sulphuric acid *in vacuo*, it melts at 115° C.; when anhydrous, it melts at 138° C. If heated between two watch-glasses it sublimes in light shining leaflets, like benzoic acid. When heated, it diffuses an odour like cumarine, fuses, and congeals in a crystalline state. It burns with a luminous smoky flame. The aqueous solution is not coloured by perchloride of iron. If rendered alkaline with any base, the liquid takes, on exposure to the air, an intense and characteristic cherry-red. The hypochlorites turn the solution a splendid purple-red, which disappears again on the addition of excess. The neutral solution reduces nitrate of silver at a gentle heat. If heated with Trommer's liquid, suboxide of copper is deposited. The dilute solution is not precipitated by dilute acetate of lead; an acid acetate gives a white precipitate, which gradually becomes red. The solution readily decomposes the metallic oxides; only the salts of barium, calcium, and copper have been examined. The behaviour of the new acid with fusing potassa throws most light upon its constitution; if heated therewith in the proportion of 1 : 3, until hydrogen gas is freely evolved, it is decomposed, the products being orcin and acetic acid, both of which can be isolated and separated in the known manner. To remove all doubt, the orcin thus obtained was purified and submitted to analysis; the decomposition, therefore, may be thus expressed—

$$C_9H_{10}O_3 + H_2O = C_7H_8O_2 + C_2H_4O_2.$$

According to this behaviour it is probable that the acid is closely related to evernic acid, which yields also orcin, and consists of $C_9H_{10}O_4$. It is also plain that the acid is isomeric with mono-acetyl-orcin. The author proposes the name alorcinic acid. We may suppose that alorcinic acid is one of the first transformation products of aloes on fusing with potassa, and that the orcin obtained results from a further decomposition of this acid.

Addition of Cyanamid.—Dr. E. Baumann.—An examination of the behaviour of cyanamid with various compounds containing the group (NH_2), in order to aid in determining the constitution of creatin and glycocyamin, and to obtain further bodies belonging to the same series.

Examination of certain Alkaloids.—Dr. Weidel has succeeded in obtaining from alkaloids well-defined oxygenated compounds, free from nitrogen, which will probably throw a new light on the constitution of these important bodies. This result has been already obtained with cinchonine, berberine, and veratrine, and it would seem that all true alkaloids behave in a similar manner. The preliminary experiments are most advanced with cinchonine, which, when oxidised in a peculiar manner, yields two azotised compounds, one of which has an acid nature, forming definite crystals and finely crystallised salts. This acid, on treatment with nascent hydrogen, gives off its nitrogen as ammonia, and is transformed into a non-azotised strong tribasic acid, also crystalline, and which, in its general properties, strongly resembles certain vegetable acids. The second compound produced during the oxidation of cinchonine is also crystallisable, but requires further study. Cinchonine, $C_{20}H_{24}N_2O$, appears to include two atomic groups, the one containing C_{11}, and the other C_9. The former acid, whose nitrogen is capable of elimination, appears to be derived from the group C_{11}.

Isomeric Dinitrophenols.—H. Huebner and Werner Schneider.—Reserved for full insertion.

Nature of a Sulpho and Sulph-nitro-bibrombenzolic Acid.—By H. Huebner and R. Douglas Williams.—This paper examines in how far the sulphoxylic group has a tendency to render the bromine in a benzol compound replaceable. The investigations of Engelhardt and Latschinoff (*Zeitschrift fur Chemie*, 1870, 230) have shown that the chlorine in bichlorbenzol is not made so far replaceable by the admission of a nitro group that bromine can be readily substituted when the compound is boiled with potash lye at ordinary pressure. It was then conceived to be possible that the sulphoxyl group along with a nitro group might convert bibrombenzol (which is closely analogous to bichlorbenzol) into a decided polybasic acid. Experiment showed that the sulphoxylic group has very little influence upon bromine.

Synthesis of Carbazol.—By C. Graebe.—The author has previously announced the fact of this synthesis. Aniline was slowly conducted through a porcelain tube maintained at full redness. A shining charcoal is deposited, whilst a liquid distillate collects in the receiver, and hydrogen, hydrocyanic acid, and ammonia are evolved abundantly. The distillate was treated with hydrochloric acid to dissolve unchanged aniline and a liquid base, which boils at a higher temperarure. The residue was extracted with alcohol. The alcoholic filtrate yielded on sublimation, after evaporation to dryness, foliaceous crystals, partly coloured, and partly colourless, and possessing the properties of impure carbazol. On combining it with picric acid, red crystals were obtained, which in form, colour, fusion-point (182° C.), and solubility agreed completely with the carbazol-picric compound described by the author and Glaser. The carbazol thus obtained fuses at the correct point (238° C.), crystallises from alcohol and benzol in white scales, and agrees in solubility with the carbazol from coal-tar. It displays the characteristic behaviour with sulphuric acid, in which it dissolves with a yellow colour, which, on the addition of nitric acid, passes into an intense green. Carbazol is therefore found, though but in small quantity, among the products formed when aniline is passed through an ignited tube. It is also obtained by passing diphenylamin very slowly through a porcelain tube heated in the same manner.

On Phenanthren.—By C. Graebe.—This long and important paper is reserved for full insertion.

New Production of Tetrabromide of Carbon from Bromoform.—By J. Habermann.—Hlasiwetz has remarked that when bromoform remains in contact with bromine in excess, and with an alkaline lye, it is frequently in course of time converted into a solid tetrabromide of carbon. The author has since determined the conditions of this change. The agency is light. In a series of experiments 20 grms. of bromoform and 13 grms. of bromine were placed in contact, and covered with dilute potassa lye. Several flat-bottomed bottles of white glass, containing this mixture, were exposed to direct sunshine,

others to diffused light, and others were placed in the dark. In the bottles exposed to direct sunlight the whole of the bromoform had disappeared, and a crystalline mass of tetrabromide of carbon had taken its place in five to six days. In those placed in diffused light the same change occurred in double the time, whilst in those kept in darkness a mere trace of the tetrabromide could be found after the lapse of three months. The transformation of bromoform in CBr_4 takes place as follows:—

$$CHBr_3+Br_2+KHO=CBr_4+KBr+H_2O.$$

The potassa lye can be replaced by water. Bromoform mixed with bromine, and covered with water, is slowly converted under the influence of light into tetrabromide of carbon, with formation of bromide of hydrogen.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 18, March 6, 1873.

The Manure of Agen and the Phosphates of the South.—A description of the manure works of M. Jaille, at Agen, on the Garonne.—Animal matters, such as horns, hoofs, blood, wool, leather-waste, &c., are carefully freed from extraneous impurities, and are then steamed at pressures varying from 11 to 15 atmospheres. By this treatment they are disaggregated, and sometimes liquefied. They are then removed from the cylinders, dried, powdered, and used in compound manures. The phosphates are obtained from the department of Lot. They are finely powdered, and are then mingled with an equal weight of sulphuric acid at 52° B. (about 1·57 sp. gr.) in order to convert them into superphosphate. We remark, with surprise, that M. Jaille does not manufacture his own sulphuric acid. The compound manures contain 45 to 50 per cent of superphosphate along with the nitrogenous powder above mentioned, and certain quantities of sulphate of ammonia and alkaline nitrates. The manure shows, on analysis, 7 to 10 per cent of nitrogen, 25 to 30 of soluble phosphate, and 1 to 3 of potassa. It is sold at 25 francs for 100 kilos., or about £10 per ton, a price which it is amply worth if the composition be as stated above. It is generally applied to the land to an extent of 400 to 500 kilos. per hectare. Any portions of the animal matter which resist the action of steam are set aside and used in the composition of special manures for vines.

Moniteur Scientifique, du Dr. Quesneville, May, 1873.

Products Derived from the Reaction of Bibromide of Ethylene upon Aniline and Toluidine.—A. Gretillat, of Rio Janeiro.—An important paper which does not admit of useful abstraction.

Aeration of Wines during Fermentation.—Dr. Ott.—A valuable contribution to our knowledge concerning the influence of certain low vegetable organisms upon fermentation. It appears that in white wines the principal fermentation is begun by a fungus named *Saccharomyces apiculatus*, and is continued subsequently by *S. ellipsoidens*. Other fungi play a secondary part. The germs of these ferments are found in larger or smaller quantity adhering to the grapes.

Study on the Alkaloids of the Cinchonaceæ.—D. Hesse.—An exhaustive paper which we hope to transfer to our columns *in extenso*.

Separation of Toluidine and Pseudo-Toluidine.—Dr. Bindschedler, of Basle.—Dalsace Bros., of Paris, sell a special heavy aniline, boiling between 198° and 200°, and containing little except toluidine and pseudo-toluidine. In acetylising this heavy aniline it was found to yield solid and crystallisable aceto-toluidine, corresponding in amount to a mixture of 70 per cent pseudo-toluidine, with 30 of crystallisable toluidine. The following process may be adopted for the isolation of pure pseudo-toluidine:—Dissolve 2500 grms. of oxalic acid in 25 litres of boiling water, adding afterwards 6 litres of commercial hydrochloric acid at 20° B. Into this mixture 10 kilos. of the heavy aniline are slowly poured. The whole is boiled up again, and constantly stirred whilst it cools down to 60° C. It is then rapidly filtered through flannel to separate the crystalline deposit. This is pressed, ground up with a little cold water, and pressed again. On decomposing it with caustic soda and distilling, crystalline toluidine is obtained, fusing at 450° C. To the filtrate we add, with constant stirring, 2 kilos. of oxalic acid, which determines a further crystalline deposit. This consists of a mixture of oxalates of toluidine and pseudo-toluidine, which, from its richness in the former, serves to prepare a further quantity of that base. The mother-liquors from this second crystallisation, completely cooled after filtration, are tested with a concentrated aqueous solution of oxalic acid. The mixture is strongly agitated, and if no further crystalline deposit is formed (in which case it must be filtered again) an excess of caustic soda is added, and the whole submitted to distillation. The oily layer which floats on the condensed water is drawn off, rectified, and is a pseudo-toluidine sufficiently pure for all industrial uses, as it contains mere traces of aniline and toluidine.

Revue Scientifique de la France et de l'Etranger, No. 45, May 10, and No. 46, May 17, 1873.

These numbers contains no chemical papers.

Gazzetta Chimica Italiana, Anno III. 1873, Fascicolo III.

On Certain Derivatives of Benzylated Phenol.—E. Paterno and M. Fileti.—The action of the chloride of acetyl and of sulphuric acid upon benzylated phenol is particularly studied.

Examination of the Scientific Principles of the Art of Dressing Hides.—A. Reimer.—In this memoir the author examines the action of pure water, of lime-water and other alkaline liquids, of potash-alum, and of common salt.

Refractive Power of Saline Solutions and its Modifications.—C. A. Valson.

Fascicolo IV.

On Certain Properties of Gypsum.—Alfonso Cossa.—The author studies the solvent action which gypsiferous waters exert upon different rocks.

On the Apparent Variability of the Law of Dulong and Petit.—G. Hirn.—A physico-mathematical paper.

Experiments on the Cultivation of the Sugar-Beet, made in the Year 1872, at Grotta Rossa, in the Campagna of Rome.—F. Sestini and G. Del Torre.

Experiments on Vinification by the Method of Chaptal.—L. Moschini and F. Sestini.—This process consists in the addition of a certain quantity of powdered marble during fermentation. The results appear to have been—an increase of alcohol, amounting in one instance to more than 2 per cent; a decrease of extractive matter; a decrease in phosphoric and sulphuric acids, and in chlorine.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 3, May 15, 1873.

Diamonds in the Sands of California.—Professor Silliman having received from Mr. Trendwell, of San Francisco, a small parcel of the sand resulting from the hydraulic treatment of ores, found, on examination with the microscope, that they abounded in fine colourless zircons of the form of those of Expailly, along with crystals of topaz, fragments of quartz, grains of chromic acid (chrome-iron?) and titanic acid, and globular bodies of a very high refractive power, which he believes to be diamonds. Mr. J. Torry, in a single sample of the sands washed from the gold ores of Nicaragua, found twenty mineral species, some of them very rare.

No. 4, May 22, 1873.

Distillation by Cold.—At a recent session of the Berlin Chemical Society Prof. Smée proposed a method for detecting organic matters contained in the air, and for effecting at the same time a kind of distillation by cold. A glass funnel, closed at its narrow end, is held suspended in the air and filled with ice. The moisture of the air is condensed in contact with the exterior surface; it trickles to the bottom of the apparatus, and falls into a small basin placed for its reception. The liquid obtained in a given time is weighed. It generally contains ammonia, which is determined by known methods. Distillation by cold may be employed for separating volatile substances which might be injured by heat. Thus if flowers are placed under a large bell-glass along with the refrigerating funnel, a liquid is obtained in the basin saturated with the odorous principles of the flowers.

Journal für Gasbeleuchtung und Wasserversorgung, Nos. 2, 3, 4, 1873.

These only contain papers relating to gas- and water-works engineering and management.

No. 5.

Sal-Ammoniac in the Hydraulic Main.—R. Gasch.—While the hydraulic main of the gas-works at Dresden was being cleaned a large quantity of a whitish-coloured saline mass was met with, mixed up with the inspissated tar. At first this saline matter was taken to be bicarbonate of ammonia, but on being chemically tested the salt was found to be chloride of ammonium. The author found that the salt is derived from the Zwickau coals, which (see Chemical News, vol. xxvi., p. 226) contain a considerable quantity of common salt. Sal-ammoniac is now a regular by-product of the Dresden gas-works.

Nos. 6 and 7.

These only contain matter relating to gas- and water-works engineering and management.

Bayerisches Industrie und Gewerbe-Blatt, February, 1873.

Soldering of Iron and Steel.—Ph. Rast.—So-called German silver may be applied to soldering steel to iron and iron to copper. Borax should be used as a flux, and the German silver granulated as is done for hard brass solder.

Gilding of Iron.—W. Kirchmann.—Sodium amalgam is first applied to the iron, which is hereby readily coated with mercury. Next a concentrated solution of chloride of gold is applied to the mercurially coated surface; and lastly, the object is strongly heated, either in a muffle or in the flame of an enameller's lamp.

March and April.

These contain no articles relating to chemistry.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 3, 1873.

Solubility of Saline Mixtures.—F. Rüdorff.—In the introduction to this first portion of an exhaustive monograph a *résumé* is given of the labours of Gay-Lussac, H. Kopp, C. J. B. Karsten, G. J. Mulder, and C. v. Hauer, on this subject. The author then treats on the solubility of saline mixtures—(1), of such salts with which a chemical decomposition cannot take place, salts containing either the same base or the same acid; (2), saline mixtures which admit of double decomposition, salts therefore containing either two bases or two acids.

Bulletin de l'Académie Royale de Belgique, No. 1, 1873.

Note cn Shifting Instantaneous Axes and Central Axes in a Solid Body in Motion.—M. de Tilly.—These notions, which in most treatises on kinematics, are preceded by a large number of preliminary propositions, the author seeks to establish in a more simple, *a priori* manner.

Note on a Singular Configuration of Spots on the Planet Mars, observed by P. Secchi on 18th Oct., 1862.—Dr. F. Terby.—In comparing P. Secchi's drawing of the appearance of Mars on that occasion with those by Mr. Lockyer, from observation made only 36 minutes later, Dr. Terby remarks on the round dark spot with luminous ring, represented in the former only, and which Secchi supposed to be from a cyclonic movement on the ocean of De La Rue. It has been thought that a shaded part extending outwards from beyond the ring, in Secchi's drawing, corresponded to the sea of Lockyer. But Dr. Terby gives reasons for considering Secchi's round spot itself as the sea of Lockyer, while the other just mentioned is more likely the sea of Maraloi, appearing also also in Lockyer's drawings. Dr. Lassell's and Lord Rosse's drawings give certain details which vaguely recall the drawing by P. Secchi, the sea of Lockyer being surrounded by a luminous ring.

No. 2.

This number contains no articles which call for notice.

No. 3.

On Man considered in the Social System either as a Unit, or as a Fragment of the Human Species.—M. Ad. Quetelet.—The author explains the general nature of his researches towards construction of a system of "Social Physics." In a table at the end he furnishes statistics of chest measurements on about 1,500 American soldiers, and compares these with measurements obtained by calculation from certain data; finding a close correspondence.

Researches on the Etherised Derivation of Alcohols on Acids (On Methylenic Mono-Cyanhydrine, $HOCH_2+CN$).—The author suggests that this product might be obtained by the reaction of anhydrous hydrocyanic acid on the formic aldehyde, or oxide of methylene, CH_2O. Not having been able to attempt this, he sought to fill the gap in the group of methylenic and glycollic derivatives by realising one of the corresponding alcoholic derivatives $(C_nH_{2n+1}O)CH_2+CN$; and with this view he produced *ethyl-glycollic nitrile*, $(C_2H_5O)CH_2+CN$; by reaction of phosphoric anhydride or pentachloride of phosphorus with ethyl-glycollamide—

$$(C_2H_5O)CH_2+COH_2N.$$

It is a mobile colourless liquid, with an agreeable ethery odour; density at $+5°$ is 0·915; boiling-point, at atmospheric pressure, 134°—135°. In this product he finds an illustration of the remarkable stability of oxyalcoholic combinations, methoxyle, CH_3O, ethoxyle, C_2H_5O, &c.; with regard to agents, such as chlorides, bromides, &c. of phosphorus, phosphoric anhydride, &c., which so readily attack the equivalent and corresponding hydroxyle grouping HO. He gives several examples of transformations and combinations he had succeeded in realising with these polyatomic compounds, by virtue of this property.

Annales de Chimie et de Physique, April, 1873.

Nitrification of Humus.—J. Boussingault.—The author calls attention to the spontaneous formation of saltpetre in many parts of Algeria, Spain, Hindostan, South America, and other localities. The chief portion of this memoir is, however, devoted to the discussion of the origin and mode of formation of the saltpetre in arable soil, and more particularly in soil containing decaying organic matter. From the author's researches, it appears that (1) the nitrification, even under the most favourable conditions, is a slow process; (2) that in the nitrification of humus, when proceeding in a confined space (under a bell-jar, for instance), the nitrogen of the air does not contribute to the formation of nirtic acid; (3) that, as a

rule, the process depends upon the organic matter present in the humus, and in all fertile soil, but is promoted by the presence of certain bases.

Studies on Valerianic Acid.—I. Pierre and E. Puchot. —The contents of this memoir may be summarised as follows:—Valerianic acid, obtained by the oxidation of amylic alcohol, and concentrated, boils at 178°. At 760 m.m. barom. the sp. gr. of this acid is—at 0° = 0·947; at 54·65° = 0·8972; at 99·9° = 0·8542; at 147·5 = 0·8095. The acid contains 1 equivalent of water, which cannot be eliminated by distillation. Mixed with an excess of water, the acid boils at from 99·8° to 100°, and the condensed vapours form two distinct layers of liquid, one of which is an aqueous solution of the acid, while the upper layer is the hydrated acid. Valerianic acid causes the same deviation of the plane of polarisation as does cane sugar. Butylic valerianate exhibits the same phenomenon, but in a less marked degree.

Researches on the Expansion and Compressibility of Gases.—E. H. Amagat.—Illustrated by woodcuts and tables. The main results of the exhaustive researches herein described are:—(1) Unless gases are well dried, their expansion is (the vessels in which the operations take place being quite dry) not so great as has hitherto been assumed; (2) the differences of the coefficients of the expansion of gases is not, as has been sometimes stated, due simply to moisture; (3) it is impossible to base a hygrometric method on part which the moisture of the air plays in its expansion, because, even when the hygrometric condition of the air differs greatly, the variation of the coefficient is difficultly appreciable.

Polytechniches Journal von Dr. E. M. Dingler, first number for March, 1873.

Application of Titration for the purpose of Estimating the Degree of Alkalinity of Beet-root Juices used in Sugar-Making.—F. Jicinsky.—Nitric acid (sp. gr. 1·2), diluted with 150 times its bulk of pure distilled water, is taken as the standard acid. 1 c.c. of this acid corresponds, by the application to 10 c.c. of juice, to 0·01 per cent of alkalinity in reference to lime. The author describes, and illustrates by woodcuts, the apparatus employed by him for the titration operation. Litmus tincture also is used to indicate the progress of the operation.

Volumetric Estimation of Sugar.—F. Weil.—A previously-weighed or measured quantity of a solution of grape sugar, or of cane sugar first converted into grape sugar, is added to a measured quantity of Fehling's sugar-testing cupreous fluid (to be used in excess, so that after the operation the blue colour yet prevails); the precipitated copper is removed from the solution by decantation, and the quantity of that metal determined by analysis, care being taken to ascertain the total quantity of copper present in the solution. 317 grms. of copper correspond exactly to 180 grms. of grape sugar ($C_{12}H_{12}O_{12}$), or to 171 grms. of cane sugar ($C_{12}H_{11}O_{11}$).

Preparation of Pure Oxalic Acid.—Dr. Habedonck.—The oxalic acid of commerce is treated with the smallest possible quantity of absolute alcohol, which only dissolves the real acid, leaving oxalates of lime, potassa, ammonia on the filter, through which the alcoholic solution passes, The acid crystallises from the alcoholic solution, and is dried at 212° to eliminate any oxalic ether which might have been formed.

Second number for March, 1873.

Contains no original papers relating to chemistry.

First number for April, 1873.

Curious Instance of the Rapid Diffusion of Specifically Lighter Gas Layers through Layers of a Specifically Heavier Gas.—Dr. M. von Pettenkofer.—In the introduction to this essay the author calls attention to the erroneous ideas on the diffusion of gases and on the proper modes of ventilation. As a curious instance of the rapidity, as well as the completeness, of diffusion, the author relates some experiments made by him at Marienbad, Bohemia, on the mineral spring there situated, from which constantly a copious supply of nearly pure carbonic acid is emitted. The gas collected under the surface of the water was found to contain 70 per cent of carbonic acid; at 5 centims. above the surface of the water there was only 31 per cent of that gas; at 25 centims. above the surface the quantity of CO_2 amounted only to 23 per cent: at 100 centims. only 2, and at 145 centims. only ½ per cent of the gas alluded to was found; thus proving that the lighter air (the spring is enclosed in a lightly-constructed wooden shed) actually descends and permeates through the heavier carbonic acid.

Detection of Adulteration in Coffee.—J. Müller.—In order to ascertain whether ground coffee has been mixed with either roasted corn or amylaceous substances generally, it is only necessary to treat the powder, first with dilute caustic potassa, and, after filtration and addition of a large quantity of pure water, a solution of iodine is added, whereby the starch is detected.

Second number for April, 1873.

Change Effected in Cast-Iron Pipes by the Action of a Sulphur-containing Water.—Dr. E. Priwoznik.—It appears that, when the iron mains conveying the mineral water from a source near Hainburg, Austria, were taken up after having been for more than a dozen years underground, the iron thereof had been strongly acted upon, as exhibited by the difference in structure upon the fracture. On being analysed, the author found the interior layer to consist, in 100 parts, of—Hydrated oxide of iron $[(Fe_2)_2O_3(OH)_6]$, 81·08; free sulphur, 12·29; sulphuret of iron, 4·48; hygroscopic water, 0·57; nickel, cobalt, magnesia, silica, traces of carbon, and chlorides of ammonium and sodium, 1·58. The second layer was found to contain only 79·2 per cent of iron, but no sulphuret or excess of carbon was discovered; while the third outermost layer was almost pure cast-iron.

Estimation of Acid in Fatty Oils.—M. Burstyn. —The oils are well mixed with twice their bulk of strong alcohol, 90 per cent at the least; this dissolves the acids which may be present in the oils, while hardly any of the latter are taken up. The alcoholic solution can be readily neutralised with a caustic soda solution of known strength. It is best to take 100 c.c. of the oil to be tested, to which an equal bulk of alcohol is added, care being taken to mix the fluids thoroughly. After some time the alcohol floats on the oil, and 20 c.c. of the former fluid should then be taken for titration. 100 c.c. of good machinery oil should not require more than from 0·4 to 1·4 c.c. of normal caustic soda solution for neutralisation.

Journal de Pharmacie et de Chimie, May, 1873.

Normal Microzymas Present in Milk considered as the Cause of the Spontaneous Coagulation; Alcoholic, Acetic, and Lactic Fermentation of that Fluid; and on the Normal Alcohol and Acetic Acid of Milk.—A. Béchamp.—The main cause of the spontaneous coagulation of milk is, according to the author, the presence therein of minute living organisms, which may be detected in the milk by first diluting it with from five to six times its bulk of creosote water (neither the degree of concentration, nor the mode of preparation of this fluid, are quoted), and next filtering the milk, care being taken to protect the filter from dust. The filter is first washed with ether, for the purpose of eliminating the butter; next, with a dilute solution of carbonate of soda, for the purpose of dissolving some caseine; and lastly with distilled water. On inspection with the microscope (magnifying power 500 diameters) the microzymas will be seen. In order to prove that the coagulation of milk is really due to these

organisms, the author states that he collected milk directly from the udders of a cow, filtered it through fine muslin previously washed with creosote-water, and caused the milk to flow into a vessel containing creosote-water and filled with carbonic acid gas, which was constantly passed through the milk. The vessel and milk quite saturated with that gas was next hermetically sealed, and placed in a drying-stove heated to from 35° to 40°; after two days, the milk was found to be coagulated. The author further ascribes to the microzymas the formation, in sour milk, not only of acetic and lactic acids, and also alcohol, which substances, however, also occur, but, of course, only in extremely small quantity. In fresh milk this is proved by the fact that the latter fluid yields, by distillation, after having been acidified with a slight excess of oxalic acid, alcohol and acetic acid. It should, however, be borne in mind that fresh milk always exhibits an alkaline reaction.

Jordery's Process for Preventing Accidents with Petroleum (Paraffin Oil).—M. Troost.—This paper treats on a proposition made by Jordery to convert petroleum into a butter-like mass by means of the addition of pulverised *Saponaria* root, previously mixed with some water. The result is, that a thick emulsion is formed which is far less inflammable than the oil itself. In order to restore the latter to its usual state, and render it fit for use to burn in lamps, it is only necessary to add to it a small quantity of pure carbolic acid (crystalline) or strong acetic acid. The author states, however, that also (owing to the expense of the *Saponaria* root, a product from the Levant) this process is not as yet practicable on the large scale.

Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin, January, 1873.

Contains no papers relating to chemistry.

NOTES AND QUERIES.

Bursting of Cast-Iron.—A correspondent has forwarded the following extract from the *British Colonist*, a Halifax (Nova Scotia) paper, in the hope that some of our correspondents may be able to throw some light upon the curious phenomenon recorded in it:—"On Tuesday afternoon, while some workmen in Mr. John Hunter's foundry, Sackville Street, were engaged in breaking up a large block of cast-iron by the usual process, the mass burst with a loud report, one of the pieces striking one of the *employes*, a young man named Kennedy, causing serious internal injuries, from which he died yesterday morning. The deceased was one of the "Kennedy" boat crew of four who recently rowed against and defeated four oarsmen from H.M.S. *Royal Alfred*.

Cleaning Silver Articles.—The Boston *Journal of Chemistry* gives the following interesting account of the way in which the natives of East India clean silver articles. The East Indian jewellers never touch silverware with any abrasive substance. For all articles of the kind, even the most delicate, the method of cleaning they adopt is as follows:—Cut some juicy lemons in slices; with these rub any large silver or plated article briskly, and leave it hidden by the slices in a pan for a few hours. For delicate jewellery, the Indians cut a large lime nearly in half, and insert the ornament; they then close up the halves tightly, and put it away for a few hours. The articles are then to be removed, rinsed in two or three waters, and consigned to a saucepan of nearly boiling soapsuds, well stirred about, taken out, again brushed, rinsed, and finally dried on a metal plate over hot water, finishing the process by a little rub of wash-leather (if smooth work). For very old, neglected, or corroded silver, dip the article, with a slow stirring motion, in a rather weak solution of cyanide of potassium; but this process requires care and practice, as it is by dissolving off the dirty silver you obtain the effect. Green tamarind pods (oxalate of potash) are greater detergents of gold and silver articles than lemons, and are much more employed by the artisan for removal of oxides and fire-marks.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 38.—" . . . it is quite clear that both these experimentalists met with certain disturbing forces in the course of their inquiries for the cause of which they could not satisfactorily account, nor for the remedy of which did they make any successful attempt; but against which it has become very requisite that every precaution should be taken in the pursuit of any new experiments."

P. 39 (speaking of anomalies in his earlier experiments).—" . . . . . the arc of vibration during one and the same experiment would seldom decrease in the regular manner which it ought to pursue if the torsion-rod were guided by an uniform influence; and, moreover, that in fact it would frequently *increase* contrary to all the known laws of bodies so circumstanced. I also remarked the same generally *increasing* tendency of the resting-point of the torsion-rod towards the masses when they were brought round to their *near* position." . . . . "But totally different from either of these, and not to be explained on the same principle, was the frequent *spontaneous* motion of the torsion-rod when the masses were remaining in their *neutral* position where they could not exert any influence; I mean those occasional and more extraordinary movements in the arc of vibration which would frequently occur without any apparent cause. In these cases, the *time* of vibration would seldom differ from its mean period, and the *resting-point* would seldom vary from its usual position; but the arc would increase from little or nothing to a very considerable magnitude, and in some instances to such a degree that the balls would strike against the sides of the torsion-box. After continuing for some time in this oscillatory condition, the arc would gradually decrease, and the torsion-rod would ultimately recover its usual state of repose. These phenomena are the more remarkable, since in most of them during the whole period the weather has been generally very calm; and as to temperature, I have seldom been able to discover any material change in the thermometers distributed about the room."

"Notwithstanding these interruptions, I not only considered it proper to continue the experiments for some time in the usual manner, in the hope that I might thereby eventually throw some light on the probable cause of the anomalies, and perhaps be enabled to apply a correction for the effect of their influence; but also was induced to institute several new courses of experiments, as circumstances and suggestions occurred, for the express purpose of elucidating the subject. The theories of electricity, magnetism, temperature, and currents of air . . . . were successively and frequently appealed to, and various experiments made to discover their probable effect on the results. . . . . Red-hot balls and powerful lamps were occasionally applied near the torsion-box with a view to raise an artificial temperature, and thus create a powerful influence; and, on the other hand, masses of ice have been employed for a similar purpose."

"I am principally indebted to Professor Forbes, of Edinburgh, for the most satisfactory removal of the principal anomalies that I had met with. This gentleman's intimate acquaintance with the theory of heat, and its various operations, effects, and influence, led him to agree with Cavendish in opinion that one source at least of the anomalies might arise from the *radiation of heat* from the masses when they were brought up to the sides of the torsion-box; and that this might even still operate, notwithstanding the interposition of the sides of the box and the intermediate boards already alluded to. As a remedy for this influence, he suggested the propriety of having the masses gilt, and also of procuring a *gilt case* as a cover to the torsion-box, for the purpose of preventing the effect of radiation, from whatever source it might arise. Acting upon this advice, I not only caused a gilt case to be made in the manner here proposed, but also caused the torsion-box itself to be previously covered all over with thick flannel. The masses and the plank on which they were placed were not gilt, as such an operation would be attended with some difficulty and inconvenience, but they were covered with gilt paper, and the whole of the interior of the framework was lined in a similar manner; but the 2 inch and 2½ inch leaden balls occasionally attached to the torsion-rod were gilt and burnished. And for the purpose of more effectually preventing the radiant influence of the masses, I altered the position of the stop so as to increase their distance from the torsion-box about 1½ inch more on each side. . . . . . The results soon convinced me that the proper mode had been taken for the removal of the principal source of discordance. For, although in some cases slight discrepancies may still appear to exist, as might be expected in any enquiry that involves so delicate a system of operations, yet when the discordances are of greater magnitude, they seem to be confined to one class of experiments, and to depend principally on the nature and construction of the material of which the suspension line or torsion-rod is composed, and do not materially affect the general result of the whole. In fact, I have met with very few experiments made in the regular mode of proceeding that are objectionable, or that need be rejected on account of any anomaly, properly so-called.

"I have already mentioned that the most striking evidence of a disturbing force was the irregularity in the magnitude of the arc of vibration; which has, however, now been removed by the alterations here alluded to. In order to satisfy myself that these alterations were the true cause of the removal, I have several times stripped the torsion-box of its coverings, and commenced experiments in that state; but I have always been obliged to abandon them, in consequence of the irregular influence of the masses on the arc of vibration on whichever side they were brought up."

MEETINGS FOR THE WEEK.

Monday, June 2nd.—Royal Institution, 2. General Monthly Meeting.
Tuesday, 3rd.—Royal Institution, 3. Mr. J. H. Parker, "On Roman Archæology."
— Anthropological, 8.
— Zoological, 8.30.
Wednesday, 4th.—Microscopical, 8.
Thursday, 5th.—Royal Institution, 3. Prof. Tyndall, "On Light."
— Chemical, 8. Sir John Conroy, "On the Dioxides of Calcium and Strontium." J. B. Hannay, "On Iodine Monochloride." T. Wills, "On an Ozone Generator."
Friday, 6th.—Royal Institution, 9.
— Geologists' Association, 8.
Saturday, 7th.—Royal Institution, 3. Mr. J. Morley, "On the Historic Method."

SUPPLEMENT
TO
THE CHEMICAL NEWS.

Vol. XXVII. No. 705.

ON ZINCO-BARIC CHLORIDE.

By G. J. WARNER, F.C.S.

It is well known that a concentrated solution of zinc chloride dissolves many other chlorides in large quantity. Double chloride of zinc with potassium, sodium, and ammonium chlorides have been already prepared. Barium chloride is extremely soluble in a solution of zinc chloride, sp. gr. 1·600; and if saturated the double chloride separates on cooling in small deliquescent needles. As the result of several analyses I find their composition to be—$2BaCl,ZnCl_2,4H_2O$; in 100 parts—

	Calculated.	Found.
$ZnCl_2$	32·69	33·05
BaCl	50·00	50·03
H_2O	17·31	By diff. 16·93
	100·00	100·00

The amount of zinc is somewhat too high, owing to the difficulty of separating the crystals completely from the mother-liquor. The sp. gr. of the salt is 2·845.

I have also prepared zinco-magnesic chloride, but have not yet completed the analysis.

Ardwick Bridge Chemical Works, Manchester.

ON THE AMOUNT OF ALCOHOL CONTAINED IN BREAD.

By THOMAS BOLAS.

It appears to be generally believed that the alcohol which is formed during the process of panary-fermentation is either entirely or almost entirely expelled by the operation of baking, and it may be observed that in most cases writers on panification make no reference to the presence of alcohol in bread. For example, Dr. Miller ("Elements," 2nd ed:, iii., p. 142) says—"During this baking, the alcohol formed by the decomposition of the sugar, which corresponds in quantity to that of the carbonic acid, is expelled." Experiment, however, has shown that, by distilling 2 ozs. of ordinary bread with water, and rectifying the distillate, it is easy to obtain a quantity of alcohol which is quite sufficient for recognition.

In order to determine the amount of alcohol quantitatively, about 1 lb. (½ kilo.) of each sample was distilled with water, an addition of about ½ c.c. of oil being made to moderate the frothing, and the distillate was rectified a sufficient number of times, the alcohol being finally determined in the usual way. The results of the examination of six samples of new bread purchased at different shops in London are embodied in the following table:—

	Percentage of Alcohol.
I.	0·245
II.	0·221
III.	0·401
IV.	0·368
V.	0·249
VI.	0·399
Average ..	0·314

These samples were subjected to distillation as soon as practicable after baking, they having been obtained almost immediately after the opening of the shops; and, in order to ascertain the loss of alcohol which bread undergoes on keeping, portions of Nos. III. and VI. were exposed to the air in a moderately warm room for a week, after which time it was found that nearly two-thirds of the alcohol had evaporated, the amount remaining being 0·132 per cent and 0·120 per cent respectively. Although the presence of alcohol in the machine-made (aërated) bread would naturally create surprise, a portion of this kind of bread was, for the sake of comparison, submitted to distillation as in the above cases, and, as might have been expected, no alcohol was detected.

It is probable that the amount of alcohol contained in bread is too small to be of any dietetic importance, but it may be perhaps worth while to notice that forty 2-lb. loaves are about equal in alcoholic strength to an ordinary bottle of port.

I hope shortly to determine the amount of alcohol which dough loses on baking, not only when it is baked in large masses, but also when it is divided into small pieces (rolls) before baking.

CONSTITUTION OF HYDRACIDS IN SOLUTION, AND ON THE INVERSE REACTIONS WHICH THEY CAUSE.

By M. BERTHELOT.

The author proposes to examine the true constitution of the liquids resulting from the union of hydracids with water, and what is its influence on their chemical reactions. The degrees of heat caused by dilution yield indications. Their progressive increase with the proportion of water corresponds to the existence of certain definite hydrates imperfectly formed in highly concentrated liquids, and whose production is completed by the addition of water. The changes observed in the law of curvature of a line representing the quantities of heat experimentally determined show the formation of a group of definite hydrates, the composition of which is nearly—

$$HCl+8H_2O_2,HBr+4H_2O_2HI+4H_2O_2.$$

The existence of such definite hydrates is confirmed by proofs drawn from the study of the tension of anhydrous hydracids in their solutions. It is sufficient to examine if there exists some limit below which the hydracids cease to be carried away in a notable proportion by a gaseous current. The experimental limit at 12° C. was found to agree closely with the following proportions:—

$$HCl+6{\cdot}5\ H_2O_2;\ HBr+4{\cdot}2\ H_2O_2;\ HI+4{\cdot}7\ H_2O_2.$$

These compositions agree with those found by Binear, Roscoe, and Dittmar. Below these proportions, however, the hydracids are still carried off, though in smaller quantity. It is not till 8 to 9 H_2O_2 that the hydrochloric acid volatilised in a gaseous current ceases to act appreciably upon nitrate of silver. The foregoing limits are slightly affected by temperature and pressure. These trifling modifications agree well with the existence of certain definite hydrates—two in number at least—one of which is stable; while the other, less hydrated and less abundant, is in a state of dissociation, partial and varying with the temperature. It is the anhydrous hydracid and not some definite hydrate which is volatilised above the limit of stability. Concentrated solutions contain, therefore, the anhydrous acid; the proportion of which, at a given temperature, may be deduced from the composition of the invariable liquids. Such solutions are in reality a mixture of one or two hydrates in which the anhydrous acid is dissolved. The precipitation of dissolved alkaline chlorides by strong hydrochloric acid may equally serve to check the state of hydration of the latter

liquid. An experiment made with a cold saturated solution of chloride of potassium gave results corresponding closely to $HCl+7{\cdot}5\ H_2O_2$. In other words, strong acid takes away from a saline solution the water necessary to convert itself into a stable hydrate. The salt no longer finding the water necessary for solution, and being, moreover, insoluble in the hydrochloric hydrate, is precipitated in proportion to the water removed. The precipitation experiments concur with those of tension and of calorimetry to show the existence of a certain quantity of anhydrous acid in concentrated solutions, and they afford a new method for ascertaining the real state of hydration of bodies in solution. In fine, the dilute solutions of the hydracids contain only definite and stable hydrates; whilst concentrated solutions contain at the same time hydrates in a state of dissociation and a certain proportion of anhydrous acid. Hence arise contrary chemical phenomena produced by these two classes of solutions; the anhydrous hydracids effecting certain reactions, such as attacking sulphide of antimony, hydrogenising, organic compound, sulphur, and sulphurous acid, &c.; whilst the hydrated hydracids are inactive, or even produce inverse actions. The reversion of their reactions corresponds always to a reversal of their thermic sign; as the stable hydrates of the hydracids develope, at least in their reactions, the heat which has been disengaged at the moment of actual combination between the water and the anhydrous hydracid.

ON THE EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON, STEEL, AND BISMUTH BARS; AND IN INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

(Concluded from p. 253).

Although the cognate discovery by our countryman Page, in 1837, that iron bars produce sound on their magnetisation, has been carefully studied by Delezenne, De la Rive, Beatson, Marrian, and Wertheim, yet in the annals of science I have found only two experimental investigations, in addition to the one by Joule, on the phenomena of the elongation produced in iron rods on their magnetisation. The first is by Wertheim, in the *Ann. de Ch. et de Phys.*, 3e Serie, t. xxiii.; the second by Tyndall, contained in a paper entitled "On some Mechanical Effects of Magnetisation," published in his "Researches on Diamagnetism and Magne-Crystallic Action," London, 1870.

In Wertheim's memoir "On the Sounds produced in Magnetised Iron," all we find on the subject of the elongation of magnetised iron rods is the following:—"Here are the results of these experiments: the helix being placed so that its axis coincides with that of the bar, we do not observe any lateral movement, but only a very small elongation; this elongation rarely surpasses 0·002 m.m. [in rods about 970 m.m. long], and although visible is barely measurable; it is most pronounced when the helix [whose length was a little over ⅛th of that of the rod] encloses the extremity of the bar; it diminishes as the helix approaches the point [the centre] where the rod is clamped, and it is probable that when it is quite close to this point the elongation changes into a retraction, but I have never been able to observe the motion in this direction with any certainty. * * * I have already remarked that it was not possible for me to measure this longitudinal traction; happily Mr. Joule has supplied that omission."

Dr. Tyndall opens his paper thus:—"Wishing, in 1855, to make the comparison of magnetic and diamagnetic phenomena as thorough as possible, I sought to determine whether the act of magnetisation produces any change of dimensions in the case of bismuth, as it is known to do in the case of iron. The action, if any, was sure to be infinitesimal, and I therefore cast about for a means of magnifying it. * * * I consulted Mr. Becker, and, thanks to his great intelligence and refined skill, I became the possessor of the apparatus now to be described. * * * The same apparatus has been employed in the examination of bismuth bars, and, though considerable power has been applied, I have hitherto failed to produce any sensible effect. It was at least conceivable that complimentary effects might be here exhibited, and a new antithesis thus established between magnetism and diamagnetism."

The apparatus used by Dr. Tyndall consisted of two vertical brass rods firmly cemented into a block of stone. Between these rods, securely fixed in the stone, were placed the rods of iron whose elongation he desired to measure. On the vertical rods slid a transverse bar of brass carrying "a vertical rod of brass, which moves freely and accurately in a long brass collar. The lower end of the brass rod rests upon the upper flat surface of the iron bar. To the top of the brass rod is attached a point of steel, and this point passes against a plate of agate, near a pivot which forms the fulcrum of a lever. The distant end of the lever is connected by a very fine wire with an axis on which is fixed a small circular mirror. If the steel point be pushed up against the agate plate the end of the lever is raised; the axis is thereby caused to turn, and the mirror rotates." The angular deflections of the mirror he determined by the method of Poggendorff; that is, by viewing in a telescope the divisions of a fixed scale reflected from the mirror.

Dr. Tyndall gives the following account of his experience with this apparatus:—"Biot found it impossible to work at his experiments on sound during the day in Paris; he was obliged to wait for the stillness of night. I found it almost equally difficult to make accurate experiments, requiring the telescope and scale, with the instrument just described, in London. Take a single experiment in illustration. The mirror was fixed so as to cause the cross hair of the telescope to cut the number 727 on the scale; a cab passed while I was observing,—the mirror quivered, obliterating the distinctness of the figure, and the scale slid apparently through the field of view, and became stationary at 694. I went upstairs for a book; a cab passed, and on my return I found the cross hair at 686. A heavy waggon then passed, and shook the scale down to 420. Several carriages passed subsequently; the figure on the scale was afterward 350. In fact, so sensitive is the instrument, that long before the sound of a cab is heard its approach is heralded by the quivering of the figures on the scale.

"Various alterations which were suggested by the experiments were carried out by Mr. Becker, and the longer I worked with it the more mastery I obtained over it; but I did not work with it sufficiently long to perfect its arrangement. Some of the results, however, may be stated here.

	Figure of Scale.
Bar unmagnetised	577
,, magnetised	470
,, unmagnetised	517

"Here the magnetisation of the bar produced an elongation expressed by 107 divisions of the scale, while the interruption of the circuit produced only a shrinking of 47 divisions. There was a tendency on the part of the bar, or of the mirror, to persist in the condition superinduced by the magnetism. The passing of a cab in that instance caused the scale to move from 517 to 534,—this

* Read before the National Academy of Sciences, in Cambridge, Mass.

is, it made the shrinking 64 instead of 47. Tapping the bar produced the same effect.

"The bar employed here was a wrought-iron square core, 1·2 inch a side and 2 feet long.

"The following tables will sufficiently illustrate the performance of the instrument in its present condition. In each case are given the figures observed before closing, after closing, and after interrupting the circuit. Attached to each table, also, are the lengthening produced by magnetising and the shortening consequent on the interruption of the circuit.

Circuit.	Scale 10 cells.	
Open	647	
Closed	516	131 elongation.
Broken	581	65 return.
Open	637	
Closed	509	128 elongation.
Broken	579	70 return.
Open	632	
Closed	491	141 elongation.
Broken	568	77 return.

Circuit.	Scale 20 cells.	
Open	653	
Closed	475	188 elongation.
Broken	579	114 return.
Open	638	
Closed	452	186 elongation.
Broken	568	116 return.
Open	632	
Closed	472	160 elongation.
Broken	561	89 return.

"These constitute but a small fraction of the numbers of experiments actually made. There are very decided indications that the amount of elongation depends on the molecular condition of the bar.* For example, a bar taken from a mass used in the manufacture of a great gun at the Mersey Iron-works, suffered changes on magnetisation and demagnetisation considerably less than those recorded here. I hope to return to the subject."

That the tilt of the mirror in this instrument should be controlled alone by the molecular motions of the bar was hardly to be expected from a critical examination of the construction of the apparatus. The sudden upward push on the fulcrum might readily cause a minute permanen displacement of this delicate axis, and this change of r sition being greatly magnified by the lever and m would affect considerably the mirror's subsequent pc of repose. Also, if on the above sudden and impulse the long arm of the lever received manent flexure, or if the slender wire conr of this lever-arm with the mirror-axi slightly elongated, these strains would d of position in the mirror after contact was broken. The marked want of stabil. readings I attribute to the fact that the ne indicating apparatus was placed on long rods, whose upper ends were unrestrained from pa..aking of tremors whose pulses were synchronous with the time of vibration of its system of weighted rods. These tremors transmitted through the ground to them caused the apparatus to partake of the nature of an instrument known to astronomers as "Hardy's Noddy," which is a species of inverted pendulum, and was even used by Captain Kater to detect any vibrations in the support of the pendulum used in his celebrated "Experiments for Determining the Length of the Pendulum vibrating Seconds" (*Phil. Trans.* 1818, p. 42).

(To be continued.)

* This fact had previously been shown by Joule's experiments.

REPORT ON A MEMOIR OF M. BERTIN RELATIVE TO THE RESISTANCE OPPOSED BY THE HULLS OF SHIPS TO ROLLING MOVEMENTS.*

M. Bertin gives in his memoir the results of experiments made on the decrease of rolling in calm water resulting from the passive resistance referred to, and the measurement of this resistance. He points out that the maximum amplitude of rolling is not sufficient to characterise ships with regard to the importance of their oscillations. Distinguish between the maximum amplitude, which M. Bertin proposes to call the *mobility*, and the mean and habitual amplitude which he calls the *agitation*, and which, relatively reduced, may be called by contrast the quietness (tranquillity). There are ships of great maximum rolling and of small maximum rolling, agitated and quiet, which must not be confounded with ships unstable and very stable: for very stable ships are in general very much agitated by rolling. To ascertain the laws of quietness in ships, it is necessary to measure both the waves and the rolling; and the instrument M. Bertin uses for this is one somewhat similar to that used by Mr. Froude. It consists of two pendulums, one of which takes 50 seconds and the other half a second in oscillation. Suppose a wave of 5 seconds, the period of the large pendulum will be ten times its duration, that of the smaller a tenth. If they are not too far from the axis of rotation of the rolling they will mark with reference to the ship's vertical longitudinal plane, the first one the absolute rolling, the second the relative rolling of the ship on the normal of the wave; provided always (for the second assertion) the dimensions of the wave are considerable with reference to the volume of hull carried by it. The difference of these two angles will be the inclination of the waves. Tracing-pencils fixed at the extremities of equal radia give two curves which can be easily examined and discussed. The Commission speak of M. Bertin's memoir as being one of considerable interest.

* Abstracted from *Comptes Rendus*.

CORRESPONDENCE.

MILK OF BENGALI COWS.

To the Editor of the Chemical News.

of your readers may be interested by the esults of some analyses which I have lately ne milk of our little Bengali cows.

solids, as noted in the third column, were esti- d by heating 5 grms. of the milk in a platinum dish four hours in a steam-bath.

Casein was estimated by Mr. Wanklyn's now well-known method.

To estimate the sugar, 20 c.c. of the milk, mixed with 40 c.c. of alcohol, were put aside in a small flask for twenty-four hours. After filtering and washing, the fluid was evaporated to a syrupy consistence upon a water-bath. The residue was then made up with water to 100 c.c., the solution passed through a dry filter, and the sugar in it estimated by means of the copper solution.

Fat was estimated by two methods. One, the old method of evaporating to dryness 20 c.c. of the milk, mixed with sulphate of lime, and subsequent exhaustion with ether. The other method was as follows:—10 c.c. of the milk, with 10 c.c. of alcohol and 10 c.c. of ether, were introduced into a glass tube of about 50 c.c. capacity. The tube was then sealed, and exposed in a water-bath to a

temperature of 180° F. for about two hours. When the tube had cooled, its end was broken off, the fluid contents drained into a small flask, and the solid matter remaining in the tube exhausted of fat by two or three boilings with ether. The contents of the flask were evaporated to about 10 c.c., then ether added to dissolve the fat, the ethereal solution separated, and evaporated to dryness in a very small weighed glass beaker. Before calculating the weight of the fat, the solubility in ether of the residue in the beaker was ascertained.

Anyone wishing to try this method of estimating the fat of milk, but who is unprovided with the means of sealing up the fluid in a glass tube, will find one of the long old-fashioned eau-de-Cologne bottles answer the purpose. The bottle must be provided with a very good cork, which must be tied down. The water-bath may be a tall cylindrical tin vessel. The bottle should be immersed to within an inch of its mouth in the water.

The following is the ordinary food of a Bengali cow, but the animal in the Bengali's hut plays very much the part of the Irishman's pig, and, with its master, has occasionally to manage as it best can:—About 12 lbs. of rice straw, 2½ lbs. of oil-cake, 1 lb. of husks of rice, sometimes a little very poor grazing, the water in which the family rice has been boiled, and about 35 lbs. of water.

	Age of Calf.	Weight of Milk given by the Cow each Day.	Solids of Milk.	Casein.	Sugar.	Fat.	Salts.
	Months.	Lbs.	Per cent.				
1.	1	6½	15·12	5·50	3·98	4·98	0·76
2.	2	5	12·82	4·30	4·40	3·60	0·70
3.	2½	5	15·28	5·76	4·10	4·10	0·84
4.	5	4	11·90	4·30	4·37	2·52	0·78
5.	6	10	12·04	4·30	4·10	3·20	0·70
6.	7	5	11·65	5·40	3·86	1·90	0·82
7.	10	4	11·92	4·20	4·37	3·00	0·68
8.	This cow is two months in calf, and is milked only about once in two or three days.		15·90	7·76	3·40	4·10	0·90

—I am, &c.,

F. N. Macnamara.

Calcutta, April 10, 1872.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus employed in the manufacture of salt. Otto Ernest Pohl, salt manufacturer and merchant, Liverpool, Lancaster. October 22, 1872.—No. 3116. The object of my invention is to produce salt in a merchantable condition at less cost. For that purpose I proceed as follows:—First. As means for economising fuel I arrange ordinary or convenient evaporating pans, one on the top of or over the other, and pass the flames, heating gases, or products of combustion over the brine at the lower pan, and at the same time under the bottom of the top pan. Doors are provided for withdrawing the salt from the bottom pan. Series of double pans may be used, and the flames, heating gases, or products of combustion and steam led over the brine. Second. As means for providing a cheap and durable cover for evaporating pans I construct such covers of a combination of wood or other suitable material and lead, lead being used to line the wood or other material forming the frame.

Improvements in furnaces for burning sulphurous ores. Alfred Vincent Newton, mechanical draughtsman, 66, Chancery Lane, Middlesex. (A communication from Konrad Walter, Augsburg, Bavaria). October 23, 1872.—No. 3142. The grate of the furnace on which the iron or copper pyrites (reduced to a suitable size) is laid is formed of bars which are capable of rocking in their bearings. These bars are made of such a section that when in their normal position the spaces between them will be sufficiently narrow to ensure the retention of the ore in the grate, but when rocked will open spaces for the discharge of the ore that lies next the bars.

Improvements in protecting walls and other erections of brick, stone, iron, and wood from moisture. Robert Knott, chemist, Bolton, Lancaster. October 24, 1872.—No. 3154. This invention consists in the use of glue or similar substances and a salt, as bichromate of potash, to render it insoluble.

Improvements in obtaining caustic baryta. Thomas Cobley, Dunstable, Bedford, and John Edgar Poynter, Glasgow, Lanark. October 28, 1872.—No. 3194. In carrying out the invention barium sulphide is mixed with heavy oil or creosotic liquor and submitted to distillation. A combustible gas is obtained, and after being freed from sulphur compounds may be used as an illuminating gas, or as a fuel. The caustic baryta may be washed out of the residue, or it may be applied in many cases in its crude coke-like form.

Improvements in the manufacture of white-lead and apparatus therefor. William Thompson, 101, Wandsworth Road, Surrey. October 29, 1872.—No. 3202. This invention relates to improvements in the process of and apparatus used in manufacturing white-lead. The melting pan is made in compartments for regulating the temperature and securing the purity of the blue lead. This lead is made into thin sheets of open texture by pouring it into a revolving cylinder kept cool, and it is granulated by running it in a thin stream between a roller and an inclined knife, and receiving it in water. The sheets and granules are charged on trucks which are run upon rails into the chambers where the chemical reagents act on the lead so as to convert it into white-lead; the trucks charged with the converted lead being run out at opposite doors.

Improvements in bleaching textile fabrics and other fibrous materials. Baldwin Fulford Weatherdon, C.E., 77, Chancery Lane, Middlesex. (A communication from John Palliser, Robert McDowell, Adolphe Klopsk, and Victor Grumel). October 31, 1872.—No. 3231. This invention consists in bleaching textile fabrics and other materials, without any previous preparation, by immersing them in a bath composed of chlorine, soda-salt, and sub-carbonate of soda neutralised by exposure to the oxygen of the air for a certain time.

Improvements in gas lamp blowpipe apparatus, part of such improvements being applicable to other spirit lamps. John Robert Harper, Clerkenwell, Middlesex. November 1, 1872.—No. 3233. The first part of these improvements consists in so constructing and regulating the aperture or apertures of the jet pipe or burner as to admit of benzoline, paraffine, naphtha, or other analogous oils or spirits being employed for generating gas under pressure in the oil or spirit vessels of gas lamp blowpipe apparatus. Another part of these improvements consists in applying two or more jet pipes to such apparatus, and also in attaching the jet pipes to the oil or spirit vessel of gas blowpipe apparatus by means of a gas union joint or otherwise. Another part of this invention relates to the application of an improved arrangement or construction of safety valve to the oil or spirit vessels of gas blowpipe apparatus. Another part of this invention relates to an improved construction of the wick tubes or holders of spirit lamps of all kinds, for the purpose of preventing the transmission of heat from the flame to the oil or spirit in the reservoir. Another part of these improvements consists in securing the spirit lamp in the case or frame below the oil or spirit vessel by means of a self-acting locking contrivance, which holds the lamp firmly in position. Another part of these improvements consists in so arranging the vessel in which the gas is generated, and the lamp through which the jet is directed, that the flame may impinge and act upon a horizontal surface either above or below the apparatus. Another part of these improvements in gas lamp blowpipe apparatus consists in arranging and mounting a series of such separate lamp apparatus in a case or frame for directing a number of gas jets upon an extensive surface required to be thus acted upon.

Improvements in metallic alloys applicable where copper, tin, zinc, brass, Muntz's metal, and other like metals and alloys are now used. Paul Auguste Desjardin, M.D., Paris. November 1, 1872.—No. 3244. The metals used in the formation of this improved alloy, or alloys, are copper, tin, zinc, arsenic, and nickel, in various proportions, according to the use and colour required. In some cases one or more of the ingredients are omitted.

Improvements in mixing, charging, and smelting iron ores. Edward Withy and William Gibson, West Hartlepool, Durham. November 2, 1872.—No. 3252. The object of this invention is to save fuel as much as possible. In effecting this, in the first place, the ores are crushed and ground, and the smaller they are ground the less fuel they take to smelt them. Second. The pulverised ores are mixed with the required quantity of lime and water to a stiff paste, which paste is forced into moulds or through dies, in a similar manner to drain tiles, the dies being made to give such shape or form to charging sections as will afford the greatest amount of heating surface, according to the weight and strength of the materials. With these sections are charged blast-furnaces, puddling-furnaces, cupolas, and vibratory-furnaces, in manner described in Letters Patent No. 2672, A.D. 1872, and more especially they are used in the improved puddling-furnaces described in said Letters Patent.

Improvements in fixing salt pans and in arranging the furnaces under the same. Joseph Parks, Wincham Boiler Works, Northwich, Cheshire. November 2, 1872.—No. 3260. According to this Provisional Specification the pan is supported on pillars, so that the whole or nearly the whole of the bottom becomes available as heating surface.

Improvements in the production of oxygen gas. James Alfred Wanklyn, 11, Harrington Street, Hampstead Road, Middlesex. November 2, 1872.—No. 3261. The feature of novelty of this invention consists in utilising the chemical properties of copper and oxide of copper in the preparation of oxygen gas.

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ON ANILINE BLACK.

By CH. LAUTH.

IN May, 1869, I made public a process for dyeing aniline blacks by means of peroxide of manganese employed as mordant and oxidising agent. The practical application of this process, although it yielded results very satisfactory as regards the beauty and solidity of the blacks, was beset with difficulties, which caused it to be abandoned. But, as in this investigation I came upon several novel facts, it may be interesting for chemists desirous of carrying on further researches in the same field to know the exact conditions of my process and its attendant drawbacks.

Dyers are generally of opinion that, to dye yarns uniformly and regularly, drying must be avoided. The fixation and development of colours by means of dryings always gives rise to difficulties which are not encountered when we pass the yarn, without drying, from one bath to another. In dyeing thick bundles of cotton yarn, the interior of the hanks is much less exposed to the air than the exterior, and consequently, if the development of the colour is due to the action of the air, it is very probable that, in spite of the skill of the operator, inequalities of shade will occur. On the contrary, when the yarns are plunged successively into baths where they are uniformly moistened, and where they are in contact with the mordant and the colouring matter, there is much less probability of inequalities. In the case of aniline blacks, the inconveniences of a dry procedure have been already pointed out, and I do not see how they can ever be completely avoided.

On the other hand, aniline black, being necessarily absolutely insoluble, cannot be fixed like another colouring matter, but must be formed in the place which it is to occupy upon the fibre. To mix, with a salt of aniline, oxidising agents capable of producing the black, and to wash the yarn in such a bath until the colour is developed, is a method which does not yield good results, because the black, instead of fixing itself upon the fibre, remains suspended in the liquid. Mordanting the fibre with an oxidising agent which is soluble, or capable of being rendered so in the dye-bath, equally occasions the development of colour in the liquid, and consequently involves considerable losses.

It seemed to me that one method only for dyeing aniline blacks was practicable; fixing a salt of aniline upon the fibre in an insoluble state, and then passing it into an oxidising bath, or, inversely, fixing on the fibre an insoluble oxidising agent, and passing it subsequently into the solution of a salt of aniline. The second modification alone gives useful results; and, practically, it may be reduced to the fixation upon the fibre of oxidising agents rich in chlorine or oxygen, capable of easy decomposition, but incapable of diffusing themselves in the dye-bath and of wasting the colouring compounds with which the bath is charged. The agents in question are the higher oxides of manganese, binoxide and chlorite of lead, &c. Binoxide of manganese has especially attracted my attention.

Fixation of the Mordant.—The simplest process for fixing manganese upon cotton, wool, or silk consists in plunging these fibres into the solution of an alkaline manganate or permanganate. These salts are, unfortunately, very expensive. I had recourse, therefore, to the old process for manganese bronze, which consists in soaking the fibres in a salt of manganese (acetate, sulphate, or chloride), then passing them into caustic soda, and oxidising the protoxide of manganese thus fixed by means of chloride of lime. To get an intense black, it is necessary to mordant in chloride of manganese at 40° B., working the cotton in this bath for an hour, wring out well, then, without rinsing, pass it into boiling soda lye at 12° B., holding lime in suspension. Or the cotton may be first mordanted in a boiling manganese bath, and then passed through cold alkali. After the fixation of the oxide, the cotton is washed in much water, and passed into a lukewarm chloride of lime bath, regulating the proportion of this agent so that it may never be found in great excess, which might injure the fibre. It is best to add the chloride of lime little by little till the manganese bronze is sufficiently intense.

At first sight this method seems very practical, and, nevertheless, the difficulties met with have caused the process to be abandoned. The treatment with soda is offensive to the workmen, and roughens the cotton. The oxidation is a delicate process, as it is important not to injure the fibre. In short, if each step is simple, the whole requires precautions which yarn dyers are not accustomed to take. The process, it should be added, has given good results when applied in calico-printing.

I have endeavoured to modify the conditions of fixing the manganese. I mention a single remarkable result. A tissue, mordanted with manganese and placed in a chamber filled with ammoniacal gas, is found of a deep brown when taken out, the protoxide of manganese becoming readily peroxidised under these circumstances.

Dyeing.—The yarns, charged with manganese and well washed to eliminate all uncombined matter, are steeped in a cold acid solution of aniline. The colour is formed almost instantaneously. As soon as the bronze comes in contact with the aniline salt, the reaction takes place. The binoxide of manganese oxidises the aniline, and the black formed takes the place of the metallic compound. The operation is finished in one or two minutes, but the yarn may be left an hour in the bath without inconvenience. The proportions to be employed vary according to the intensity of the black desired. An excess of acid must be always used; thus, to 10 or 20 grms. of aniline per litre 60 grms. of sulphuric acid must be added, or to 50 grms. of aniline 150 of acid. If these limits are much exceeded the mordant may be attacked. The sulphuric acid may be replaced by other mineral acids, such as the hydrochloric, arsenic, &c. When taken out of the dye-bath, the cotton is well washed and passed into a boiling alkaline bath—soap or soda—to remove the last traces of acid and give the black its full beauty.

Brightening.—After dyeing, the shades may be modified and their intensity augmented by means of different agents. This indicates that, when the binoxide of manganese has completed its action, the colouring matter is still in a transition state, in which further oxidation may be useful.

Bichromate of potash, at 1 grm. per litre, salts of copper, mercury, and chrome, and especially a mixture of chlorate of potash, a salt of copper, and sal-ammoniac (1 grm. of each per litre), increases the intensity of the black. This treatment is applied after the washing subsequent to dyeing, and is carried on for half an hour at a boiling heat. It is followed by a second washing and by boiling in soap-lyes. The process described gives fine, solid blacks; it is speedy, and does not injure the fibre.

On the other hand, we must not forget the difficulties of the mordanting process, and the black stains off a little when rubbed.

In calico printing, my process is suitable for:—Black grounds. Black grounds, with discharge effects in all colours. Greys, produced by weaker mordants. Black patterns, along with greys and other shades capable of resisting the operations above mentioned (iron, chrome, copper, indigo, catechu, &c.). Joint application of black and indigo. Blue grounds, with white discharge and black patterns.

The nature of the coal-tar base employed is very important. Pure aniline, used alone, gives a very fine

intense black. Toluidine, a blue-grey. Methyl-aniline, a violet-black. Naphthylamine, a violet-brown.

The differences of shade are so striking that cotton cloth mordanted in this manner may be used to determine the comparative value of commercial anilines.

ON PROPYLAMINE AND TRIMETHYLAMINE, AND THEIR THERAPEUTICAL USE.

The particulars in the following account are from a recent article by Prof. Gubler, of Paris:—

It is nearly twenty years since these two artificial alkaloids were introduced into the "Materia Medica" by an eminent St. Petersburg physician, and yet their existence seems to have been pretty much ignored by the majority of practitioners till quite recently.

The experiments of Awenarius, commenced in 1854 and published ten years later, attracted attention from only a few observers; among these an eminent Belgian, M. V. Guibert.

Some years later, the Russian doctor Kaleniezenko took up the work commenced by his fellow-countryman Awenarius, and published an interesting monograph on *propylamic medicines*. While Awenarius had applied propylamine in treatment of acute febrile disease, and specially rheumatism, Kaleniezenko regarded chiefly the alterative action which he considered it to have in chronic disease, especially the manifestations of scrofulous and tuberculous diathesis. He considered that cod-liver oil owed its efficacy to the volatile alkaloids contained in it, and other substances, also containing them among their principal constituents, would act in the same way. The idea is ingenious, but it is neither proved nor probable.

In June, 1872, an original memoir on the subject appeared in Italy, and, about the same time, one in America. Both publications excited the curiosity of medical men in France and England, and the therapeutical study of propylamine is now engaging considerable attention on both sides of the channel.

Propylamine is an excessively volatile liquid with a strong penetrating odour, like that of ammonia, and which, when diffused in the air, often resembles that from the brine of herring or of sardines. It is soluble in water, which it makes strongly alkaline, combines energetically with acids, and forms salts generally soluble in water and in alcohol, and capable of exhaling an odour of fish when either heated or treated with a fixed alkali. This alkaloid is found in the flower of hawthorn, in the fruit of sorb, in several *Chenopodia*, in spurred rye, in human blood and urine, and in cod-liver oil.

Propylamine and *trimethylamine* are isomers; their formula is C_6H_9N, but they differ somewhat in structure. The first may be represented by ammonia, NH_3, in which 1 molecule of hydrogen is replaced by 1 molecule of propylene, C_6H_7; while, in the second, 3 molecules of methyl, C_2H_3, are substituted for 3 molecules of hydrogen. These differences in grouping are necessarily connected with differences in physical, chemical, and physiological properties.

The two forms of C_6H_9N are commonly found together, and, owing to their extreme volatility and facility of metamorphosis, their extraction and isolation is very difficult. They have not yet been obtained, except in the state of mixture, and probably associated with other ammonia compounds. Moreover, they have only been obtainable in aqueous solution, more or less concentrated; whether by reason of the process of extraction, or the impossibility of preserving in the free state liquids so volatilisable—one of them (propylamine) boiling at +45°, and the other at +5°. They are therefore not administered in the pure state in medicine, and this may account for some of the discrepancy of statement as to their action.

Further, the very existence of propylamine in the complex substance used in medicine has been called in question by some eminent authorities. Thus, Hofmann has sought in vain for it in the brine of herring; he has only succeeded in finding its isomer, trimethylamine. Silva, indeed, has obtained propylamine, but only in very minute quantity.

The uncertainty increases when one reflects that, according to the richness of the brine submitted to distillation, in presence of caustic potash, to expel the volatile alkalies, and according to the manner of the operation, we may obtain solutions more or less charged with active principles.

M. Petit's researches have brought to light some curious facts. He subjected to alkalimetric tests several different products sold under the name of propylamine, and with the following results:—

Using a sulphuric liquor, 1 c.c. of which exactly saturated 0·06 gr. of propylamine, he found 0·2 c.c. of the acid solution was necessary to neutralise 1 gr. of propylamine F; 0·3 c.c. for the same quantity of propylamine P; 0·6 c.c. for the product D; 1·2 c.c. for A; and 2·5 c.c. for that designated S.

Thus, the propylamine S, which contained 0·15 c.c. alkaloid per gramme, was more than ten times richer than the propylamine F, which contains only 0·012 c.c. There must be considerable disparity of action in medicines so unlike.

To all these causes of error should probably be added another, which may not be the last. Propylamine and trimethylamine, in presence of light or in contact with the atmosphere, is transformed gradually, and often quickly, into ammonia properly so-called, NH_3, and into one or several other products representing C_6H_6. In fact, propylamic solutions, immediately after being obtained, give a peculiar sweetish and slightly aromatic odour, approaching that of ammonia, but quite different; whereas, the emptied vessels, several days after, exhale the strong pungent odour of the volatile alkali, and appear, at least, to contain only pure ammonia.

Allowing for these sources of difference in observation, the following is what seems most clearly established as to the physiological action and therapeutical effects of propylamine and trimethylamine, or, rather, of propylamic solutions:—

Propylamine somewhat reddens the surface of the skin, causes a sensation of heat and burning in the first passages, and retards the pulse. Additional experiments are necessary to explain this retardation. The recent observations of Namiais do not solve the problem. He has observed, however, not only a diminution in the number of heart-beats, but a lowering of temperature and increase of the aqueous diuresis; so that he considers the action of propylamine similar to that of digitalis, but undoubtedly superior. He further observed that the pulse, retarded by propylamine, lost, at the same time, in force and fulness, indicating diminution of vascular tension, and, also, it would seem that the circulatory retardation is not produced by the same mechanism in the two cases.

Awenarius was the first to apply propylamine in therapeutics. Dr. Gaston, of Indiana, following his example, applied the alkaloid in treatment of acute articular rheumatism. Namiais, of Venice, guided, on the other hand, by his own researches, used it as a substitute for digitalis and its active principle, in cases where it was necessary to moderate the circulation and to increase the flow of urine, *i.e.*, in organic affections of the heart, and dropsies dependent on them. More rarely, he has employed propylamine to stimulate perspiration.

There followed the researches of Dujardin Beaumetz, Besnier, and several other French physicians.

Dujardin Beaumetz does not regard propylamine as a mere sedative of inflammation or of fever, after the manner of quinine, but as an agent for extinguishing rheumatism locally, and repressing its fresh appearance.

"Unfortunately, a most attentive and prolonged study of the effects does not allow me to share the convictions of our distinguished colleague. My own experience,

somewhat limited as yet, but fortified by that of Pidoux, and other practitioners in the City hospitals, reduces the use of propylamine to that of a palliative for articular inflammation and rheumatic fever, which does not prevent relapses, and has not the extraordinary power which we might have desired."

For applying to the skin, Guibert recommmends the use of pure propylamine. For mucous surfaces, it should be more or less diluted; for internal use, Awenarius prescribed it in potions of 1 to 4 grms. and more, in 125 grms. of distilled water aromatised with peppermint. This maximum has never been reached by the others. "For my own part, I have prescribed doses varying from 1 to 3 gr., and with the latter dose, I have only obtained obscure physiological results, and so slight and inconstant a retardation of the blood circulation that I could not affirm that it had the effects of medicinal action. In one case, on the contrary, I observed a general stimulating action, characterised by peripheric heat, pricklings in the skin, a tendency to perspiration, and restlessness in the limbs. But I am unwilling to draw any formal conclusion from this single fact; though it seems quite natural to expect stimulating effects from substances so closely allied to ammonia, and capable of progressive metamorphosis into a volatile alkali.

"My provisionary conclusion is this—The concordant facts observed in Russia, Italy, the United States, and France, by eminent clinicians, warrant the belief that propylamic solutions exert a favourable influence on rheumatism and phenomena of circulatory excitation; still, the demonstration of this therapeutical action is not yet furnished, and truly scientific experimentation will only commence when we shall be in possession of one or of several agents well defined and always identical."

INVESTIGATIONS ON PARA-SULPHOBENZOIC ACID.

By IRA REMSEN.

(Continued from p. 215).

III. *Formation of Parasulphobenzoic Acid from Sulphotoluenic Acid.*

WHEN substituting agents are allowed to act upon toluene, in the case of derivatives containing one substituting group, two products are formed. These are the para- and ortho- varieties. The former is always produced in much larger quantity than the latter. This has been proved by Engelhardt and Latschinoff,* and by Wolkow,† in the case of the sulpho-derivatives. Wolkow proved that the products belonged to the para- and ortho-series, by converting them respectively into paraoxybenzoic and salicylic acids. According to the experiments of the chemists mentioned, the two sulpho-acids can be separated by partial crystallisation of the potassium salts. In this way the para-salt was obtained in a perfectly pure condition, while the ortho-salt could not be freed entirely from the para-salt.

Now, as it had been shown that the oxidation of the mono-brom- and mono-chlor-derivatives of toluene yielded corresponding derivatives of benzoic acid, the idea naturally suggested itself that similar treatment of sulphotoluenic acid might yield the desired derivative of benzoic acid. My best hopes were satisfied. After a few experiments it became evident that by means of this reaction I could prepare parasulphobenzoic acid in unlimited quantity with but comparatively little labour.

The principal difficulty that presented itself was to be looked for in connection with the fact that the sulpho-acid is exceedingly easily soluble; and some method had to be devised to extract it from the oxidising mixture, provided it were formed. A preliminary experiment, made with a small quantity of the potassium salts of the sulphotoluenic acids, showed that they were easily acted upon by a mixture of sulphuric acid and potassium bichromate. Taking advantage of the suggestion of Fittig,* with the hope that the ortho-acid would be destroyed by the oxidising agents, I subjected the mixture of the two potassium salts to the influence of sulphuric acid and potassium bichromate in noted proportions. The oxidation, when once commenced by gently heating over a water-bath, proceeds rapidly to the end without the further aid of heat, and is completed in the course of a few minutes. The liquid becomes very hot, and foams somewhat; an evolution of gas takes place as long as the oxidation-process continues; and its cessation indicates the end of the operation. In order to extract the product from the mixture the whole was diluted with a large amount of water, and chalk added to the point of neutralisation. By this means the chromium oxide formed and the excess of sulphuric acid were precipitated, and in the solution remained the potassium salts of the sulpho-acid or acids, together with some neutral potassium chromate. Baryta-water was now added in sufficient quantity to precipitate exactly the chromic acid present, this filtered off, and the filtrate evaporated almost to dryness. The colourless residue consisted of the potassium salts, together with some potassium hydroxide. The mass was first neutralised with sulphuric acid, and then a sufficient quantity of the latter added to set the sulpho-acids free, care being taken to avoid any large excess. Moderately strong alcohol being now poured upon the mixture, an abundant deposit of potassium sulphate took place. This was filtered off, the salt well washed out with alcohol, and the alcoholic filtrate evaporated down again to a small volume. Potassium sulphate was again deposited. This was filtered off, washed out, &c., and the operation repeated a few times. Finally, the alcoholic solution was boiled for some time with water, and then evaporated to dryness over the water-bath. In this way the sulpho-acids were obtained in a free state without impurities. The acid barium salts were prepared, and, on bringing their solution to the point of crystallisation, large acicular crystals were at once deposited, and these possessed the characteristics of the acid barium salt of parasulphobenzoic acid already described. They were analysed with the following results:—

0·5415 grm. salt was heated above 200°, and lost 0·0495 grm. H_2O; and gave 0·2130 grm. $BaSO_4$= =0·12524 Ba.

	Calculated.		Found.
$(C_{14}H_{10}S_2O_{10})$	402	67·79	
Ba	137	23·10	23·13
$3H_2O$	54	9·11	9·14
	593	100·00	

This shows, then, conclusively that by the oxidation with sulphuric acid and potassium bichromate, the sulpho-group of parasulphotoluenic acid remains intact. The conduct of the ortho-acid under like circumstances I shall refer to below. As far as I have been able to discover, by a consultation of the literature, this is the first attempt which has been made to oxidise sulpho-acids in the manner described. The simplicity of the reaction and the satisfactory character of the results lead me to desire the further application of the principle involved, and I shall take the first opportunity to prepare a pure sulphoxylenic and sulpho-mesitylenic acid, with the object of subjecting them to the influence of oxidising agents, hoping thus to obtain an *oxybibasic* and an *oxytribasic* acid.

After having gained the necessary preliminary knowledge, I proceeded to determine the best conditions for the reaction. A large number of experiments were made, and as the result I would give the following directions:— Instead of first preparing the potassium salts of the sulphotoluenic acids, I employed a solution of the acids in sulphuric acid, considerable labour being thus saved. 25 grms. of pure toluene are dissolved in 200 grms. of

* *Zeitschrift für Chemie*, N. F., 5, 615.

† *Ibid.*, N. F. 6, 321.

* *Ibid.*, N. F. 7, 179.

fuming sulphuric acid without the aid of heat. When this solution has cooled down somewhat, two volumes of water are added, and the height of the liquid in the flask marked. Now more water is added, and the mass subjected to distillation until the liquid has reached the original volume indicated by the mark on the vessel. In this way any toluene which may have remained unacted upon by the sulphuric acid is removed. The solution is now allowed to cool to the ordinary temperature, and then 160 grms. of coarsely-powdered potassium bichromate gradually added. In order to start the oxidation the flask is placed on a water-bath, and gently heated for about ten minutes. During this time a commotion is noticed in the liquid, which gradually increases. An active foaming ensues, and when this has fairly begun the flask is removed from the water-bath. A uniform evolution of gas continues until the end of the operation, which occupies usually about twenty minutes in all. The gas evolved is carbonic acid, as was proved by appropriate reactions. In heating the mixture at first, it is absolutely necessary to place it on a water-bath; if the attempt be made to heat with a flame the flask invariably breaks. This is occasioned by the fact that the potassium bichromate lies at the bottom of the flask, and that the oxidation commences and goes on rapidly just at the spot where the heat from the flame is strongest. This spot immediately becomes very hot before the remainder of the glass has been at all heated, and from this spot a circular piece of glass inevitably drops, followed by the contents of the flask. When the operation is at an end, which, as stated, is indicated by the cessation of the evolution of gas, the whole is diluted with water, and then treated successively, as above described, with chalk, baryta-water, sulphuric acid, and alcohol. By this method, in the course of a few days, a very large quantity of pure acid barium parasulphobenzoate can be prepared.

Parasulphobenzoic Acid, $C_6H_4\left\{\begin{matrix}SO_2.OH\\CO.OH\end{matrix}\right.$, is prepared from the barium salt by precipitating the barium exactly with pure sulphuric acid, and evaporating the solution. It is very easily soluble in water, and crystallises from a very concentrated solution in the form of beautiful, colourless, transparent needles. These, though very easily soluble, are not deliquescent. They fuse above 200°, but undergo decomposition before the fusing-point is reached. The meta-acid is deliquescent.

Potassium Parasulphobenzoate, prepared by neutralising and precipitating the acid barium salt by means of a solution of pure potassium carbonate, is exceedingly easily soluble in water, but crystallises finally in well-formed transparent needles.

Acid Sodium Parasulphobenzoate,—

$$C_6H_4\left\{\begin{matrix}SO_2.ONa\\CO.OH\end{matrix}\right. + 2\tfrac{1}{2}H_2O.$$

—This salt was prepared by neutralising and precipitating the acid barium salt with sodium carbonate, and then adding hydrochloric acid to the solution, evaporating, and allowing to crystallise. It forms beautiful, long, colourless, lustrous, stellate prisms. It is moderately easily soluble in cold water, more easily in hot water. The corresponding salt of the meta-acid is more difficultly soluble in cold water, and crystallises in laminæ. The two, when present in the same solution, cannot, however, be separated. The analysis of the salt gave the following results:—

0·3707 grm. of the salt, dried over sulphuric acid, on being heated gradually to 310°, lost 0·0607 grm. in weight; and then gave 0·102 grm. Na_2SO_4 = 0·033038 grm. Na.

	Calculated.		Found.
$(C_7H_5SO_5)$	201	74·72	
Na	23	8·55	8·91
$2\tfrac{1}{2}H_2O$	45	16·73	16·37
	269	100·00	

The remarkable fact will be noticed that the water of crystallisation is not driven off entirely until a high temperature (320°) is reached. All other salts of this acid, as well as of the meta-acid, which contain water of crystallisation, exhibit the same property, though not in such a marked degree as this one.

Barium Parasulphobenzoate, $C_7H_4SO_5.Ba+2H_2O$.—This salt was obtained by neutralising a solution of the acid salt with barium carbonate. It is moderately easily soluble in cold water, very easily in hot water. It crystallises in small needles, which are grouped together in verrucose masses. The corresponding salt of the meta-acid is also easily soluble in water, but according to the descriptions given it contains no water of crystallisation. The analysis resulted as follows:—

0·4174 grm. salt, dried over sulphuric acid, on being heated gradually to 190°, lost 0·0411 grm. H_2O; and then gave 0·2587 grm. $BaSO_4$ = 0·15212 grm. Ba.

	Calculated.		Found.
$C_7H_4SO_5$	200	53·62	
Ba	137	36·73	36·44
$2H_2O$	36	9·65	9·84
	373	100·00	

Acid Barium Parasulphobenzoate,—

$$(C_7H_5S_2O_5)_2Ba+3H_2O.$$

—The methods of preparation and analysis of this salt have already been given in detail. It is by far the most characteristic salt of parasulphobenzoic acid, and its properties are such as to render its preparation in an absolutely pure condition very simple. It is exceedingly difficultly soluble in cold water. When perfectly pure the length of the crystals is only dependent upon the depth of the liquid in which they are formed. It is more difficultly soluble, both in cold and in hot water, than the meta-salt. Like the meta-salt it does not give off its water of crystallisation entirely below 200°, and it may be subjected to a much higher temperature without the danger of decomposition.

Calcium Parasulphobenzoate is an amorphous powder which is somewhat more easily soluble in cold water than in hot, and is hence thrown down when a concentrated cold solution is boiled.

When the potassium salts, obtained in the preparation of acid barium parasulphobenzoate by evaporating the solution which has been treated with chalk and baryta-water, are fused with potassium hydroxide, a mixture of paraoxybenzoic and salicylic acids is obtained, the salicylic acid forming in some cases fully half of the product. This fact taken alone led at first to the conclusion that the methyl groups of both the para- and ortho-sulpho acids had been oxidised; and that thus not only parasulphobenzoic acid had been formed, but at the same time orthosulphobenzoic acid. Further investigation, however, showed conclusively that this was not the case, but proved another interesting fact, of which I shall speak below.

IV. *Formation of Terephthalic Acid from Parasulphobenzoic Acid.*

The recent experiments of V. Meyer* have tended to materially modify the prevalent views in regard to the constitution of the bi-derivatives of benzene. Meyer showed that ordinary sulphobenzoic acid, which, on the one hand, could be converted into oxybenzoic acid, could, on the other hand, be converted into isophthalic acid by fusing its potassium salt with sodium formate. As, according to the reigning ideas, isophthalic acid can only have the constitution indicated by the 1·3 position of its carboxyl groups, it became evident that oxybenzoic acid, which up to that time had been looked upon as belonging to the same series as phthalic acid, viz., the ortho (1·2) series, in reality belonged to the meta (1·3) series, of which

* *Berliner Berichte*, iii. jahrgang, 112; and *Ann. d. Chem. u. Pharm.*, clvi., 265.

isophthalic acid is the most satisfactory representative. Salicylic acid thus became the 1·2 oxybenzoic acid, and the formulæ of a number of compounds were subsequently changed of necessity to place them in concordance with the results of the above reaction. But to take thus one experiment as the basis of a change as serious as that which ensued was looked upon by some chemists as insufficient; and indeed Meyer himself, in his first notice * on this subject, says—" Bei allen Schlüssen, die wir aus Reactionen, wie die oben beschriebene, ziehen, mahnt freilich die von Kekulé beobachtete Thatsache, dass die Phenolsulfasäure mit Leichtigkeit aus der Meta-Stellung in die Para-Stellung übergeht, zu grosser Vorsicht und ich werde daher auch die so eben aufgestellte Reihe nicht für völlig bewiesen halten, bevor ich nicht auch ein Glied der Meta-Rahe in gewöhnliche Phtalsäure werde übergeführt haben." Notwithstanding the fact that a great number of experiments were made with the object of more firmly establishing the principle adopted, by converting a member of the other series into the corresponding bibasic acid, they all failed; and the two analogous experiments of Meyer, viz., the conversion of sulphobenzoic acid into isophthalic acid, and the conversion of bromobenzoic acid into isophthalic acid, remained without support in their testimony. Attempts to apply the reaction to other fields were also unsuccessful, as shown in the experiments of Barth† and Ascher.‡ It is hardly strange, then, that with these circumstances the changes proposed by Meyer were not universally accepted; and those who opposed them on the ground that molecular re-arrangement might here play a *role* were certainly to some extent justified.

As I was now in possession of the para-acid § corresponding to the meta-acid ‖ with which Meyer performed his experiment, it became an interesting question as to what the conduct of this compound would be when fused with sodium formate.

From the pure acid barium salt the potassium salt was prepared, and, the directions of Meyer being closely followed, this salt was fused with an equal weight of pure sodium formate. In order to bring the mass to the point of fusion a comparatively high temperature was required. It then remained in a semi-liquid condition, apparently evolving gas for a short time, finally becoming much darker in colour—in fact nearly black. At a certain point volatile products, evidently containing sulphur, were given off, the odour of which was intensely disagreeable. The operation was performed in a silver crucible, and the mass constantly stirred with a silver spatula. Occasionally the vapours which were given off took fire above the crucible, and, on the gas-flame being now removed from beneath, and the flame of the vapour being extinguished, the mixture continued red-hot for a short time, presenting the appearance of a burning coal. When all had cooled down to the ordinary temperature, the crucible and contents were placed in water, and this boiled. The solution thus obtained was filtered, and, when cold, was treated with sulphuric acid. Thus was thrown down a very voluminous, flocculent precipitate, of a decidedly dark colour. In order to purify the product, it was filtered off, and well washed out with hot water; then dissolved in ammonia, and this solution boiled with animal charcoal. A nearly colourless solution resulted, and on treating this with sulphuric acid the precipitate formed was almost white. An attempt was made to prepare the barium salt by boiling with pure barium carbonate. After long-continued boiling with a large amount of water the acid had disappeared, and the salt was in solution. On evaporating gradually the salt was deposited in crusts during the process. It proved to be of exceedingly difficult solubility in water, boiling as well as cold. A small portion of it appeared to have a tendency to crystallise. This was separated from the powder and crusts, and repeatedly recrystallised. It was also very difficultly soluble in water, and yielded an acid which resembled terephthalic acid in some properties. By means of various reactions, however, it was soon proved that this was not one of the phthalic acids, and it seemed probable that it might represent a variety of the thihydrobenzoic acids, the formation of which has been shown * to take place in the reaction of Meyer for the preparation of isophthalic acid. The amount of the substance obtained was not sufficient to permit of its close examination, its perfect separation from the other substance formed being impossible. The difficulty of separation threatened at the outset to be a serious obstacle in the way of deciding the point under consideration. One method after another was tried, but the results were decidedly unsatisfactory, until finally the mixture was subjected to the influence of an oxidising agent (sulphuric acid and potassium bichromate). By this means the thihydrobenzoic acid (?) was so changed in character as to become soluble, whereas the other constituent of the mixture was left behind in a pure condition unacted upon. It was dissolved in ammonia, re-precipitated by means of a strong acid, filtered, and well washed out. In this condition it had the form of a very light, flocculent, white mass. It could be dissolved in boiling alcohol, and from this solution it was obtained in the form of microscopic needles which were deposited upon the sides of the vessel. This substance could not be brought to fusion. When heated in a capillary tube it sublimed from one part to the other before the flame, and was finally decomposed without fusing. It was almost absolutely insoluble in water, both boiling and cold; insoluble in ether. The pure substance could not be perfectly dissolved by boiling with barium carbonate. A small amount of the barium salt of the acid was, however, thus obtained, and this was very difficultly soluble in water, and did not crystallise. The calcium salt resembled this in every way.

These are the properties of terephthalic acid, with the exception of the conduct toward alcohol. To this I am not inclined to attach much weight, as the acid which is described as insoluble in alcohol is that which is obtained by oxidation of xylene, and the *condition* of this acid differs essentially from that of the light mass obtained by precipitating it from one of its salts. Further, I found that after being dried, the acid, as obtained by me, was also insoluble in alcohol. I would hence rather consider this conduct as indicating a property of terephthalic acid which had been overlooked. The substance was proved to have the composition of terephthalic acid by the following analysis:—

0·2325 grm. substance, dried over sulphuric acid, gave 0·4897 grm. CO_2 = 0·13355 grm. C and 0·0832 grm. H_2O = 0·00924 grm. H.

	Calculated.		Found.
C_8	96	57·83	57·44
H_6	6	3·61	3·97
O_4	64	38·56	——
	166	100·00	

The proofs that terephthalic acid is formed when potassium parasulphobenzoate and sodium formate are fused together are thus conclusive. It remained, however, to show that neither phthalic nor isophthalic acid was formed at the same time. The crude product was boiled with water for a long time, and then filtered off. On allowing the filtrate to cool, a small quantity of substance was deposited in the form of powder. The whole was shaken with ether, which dissolved the powder and extracted whatever might be in solution. The original solution from which the crude acid had been precipitated was also treated with ether. On uniting the ethereal solutions and distilling off the ether, a residue was obtained which dis-

* *Berliner Berichte*. iii. jahrgang, 112.
† *Berliner Berichte*, iv. jahrgang, 634.
‡ *Ann. d. Chem. u. Pharm.*, clxi., 3.
§ Para 1·4. ‖ Meta 1·3.

* Ador, *Berliner Berichte*, iv. jahrgang, 622.

solved readily in alkaline carbonates. It was neutralised with barium carbonate. The barium salt was easily soluble and crystallised well. The free acid separated from this salt was easily soluble in hot water, and crystallised out on cooling. It had the fusing-point 120°, and all the other properties of *benzoic acid*. No other substance could be found. The quantity of benzoic acid obtained was very small in comparison to the whole quantity of the product, and its formation can easily be accounted for when we consider the character of the reaction.

Here then, at least, no molecular re-arrangement takes place; and this, taken in connection with Meyer's experiment, certainly makes the case strong enough to command attention. The reaction is thus shown to be capable of application for the purpose of determining the constitution of compounds, and the changes proposed by Meyer can be demanded with greater confidence than before. The proofs that paraoxybenzoic and terephthalic acids belong to the same series had already been given * by other reactions, though, acknowledging the described reaction, this would be the most direct proof of the fact.

(To be continued).

* See V. Meyer, *Ann. d. Chem. u. Pharm.*, clvi., 267.

NOTICES OF BOOKS.

Practical Examples in Quantitative Analysis. By Ernest Francis, F.C.S., Demonstrator of Practical Chemistry, Charing Cross Hospital. London: H. K. Lewis, 136, Gower Street.

This small volume, as the author intimates in his preface, is intended for the use of medical students. It is undeniable that, if practising medical men are to fill the office of analysts under the "Public Health Act," they will certainly require a much more complete and practical knowledge of chemistry than they ordinarily possess at present.

The work treats of gravimetric, volumetric, and colorimetric analysis, the examples taken being the determination of total solids in water and in milk, of caseine in milk of total solids, uric acid and albumen in urine, of chlorides in water, of hardness in water, urea in urine, of sugar and of cream. In colorimetric analysis we find examples of the estimation of ammonia, ureal and albumenoid, and of nitrates and nitrites in potable waters. In estimating the hardness of water, we observe that the author adheres to Clarke's original method, in preference to the modification introduced by Wilson. The directions for the determination of organic impurities in water are sound, being taken from Messrs. Wanklyn and Chapman, and there is no attempt to lead the student into the unwholesome mysteries of "previous sewage contamination." It would scarcely be possible to compress a greater amount of useful matter into the small compass of 57 pages.

A Review of "Prof. Reese's Review" of the Wharton Trial. By Prof. W. E. A. Aikin, M.D., LL.D. New York: D. Appleton and Co.

A critique on the evidence given, and on the theories put forward, to establish the innocence of the defendant in a poisoning case, with general remarks upon certain points of medical—or we might say chemical—jurisprudence. Those who remember the Tawell and the Palmer trials in England, or who have read Prof. Taylor's remarks on the lines of defence then adopted, will fully appreciate the attack which Prof. Reese—a witness, or rather scientific advocate, for the defendant Wharton—thought proper to make upon Dr. Aikin.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, April 28, 1873.

Methods for the Analysis of Water.—F. Tiemann.—The determination of hardness (magnesium) of sulphuric acid, nitrous and nitric acid, ammonia, sulphuretted hydrogen, and organic matter has led to constantly renewed discussion. Hence a re-examination of the methods recommended is desirable. *Determination of Hardness.*—The process for ascertaining the amount of alkaline earths in a water is always performed with a solution of soap, and depends on the double decomposition of the fatty alkaline salts in the soap, and of the lime and magnesia salts dissolved in the water. Insoluble lime and magnesia salts are separated out, and on shaking a froth is formed as soon as the decomposition is complete, and a slight excess of soap is present in the liquid. In the course of time three essentially different methods of determining the hardness by means of a soap solution have been made known; these are the old methods originally proposed by Clark, which has subsequently received several unessential modifications, the method of Boutron and Boudet, and that of Wilson. All three require that certain proportions of volume in respect of the quantity of water employed should be observed. It is in neither of these methods a matter of indifference whether—other conditions remaining unchanged—the hardness is determined in 10, 50, or 100 c.c. of water. All three render the determination of hardness possible only within certain limits, and in case of a very hard water require its dilution with distilled water to a normal volume. Clark, and the chemists who have slightly modified his process, use as standard test a dilute solution of soap, and a normal volume which some fix at 100 and others at 50 c.c. of water. As the consumption of soap-liquor in this method does not increase in the same ratio as the amount of calcic and magnesian salts present a table becomes necessary, showing the amount of soap solution corresponding to different degrees of hardness. Such tables, adapted to various conditions of concentration, have been drawn up by Clark, by Faisst and Knauss. The cause of the unequal decomposition of the soap-liquid may, perhaps, be found in the transient formation of soluble double compounds which at the outset of the process arise on the contact of soap and of the salts of the alkaline salts in very dilute solutions. In this manner the combination of an excess of the soap-liquid may be occasioned, and thus the latter may be deprived of the power of frothing when shaken. The alkaline salts (carbonates, sulphates, and chloride) formed in hard water on the decomposition of salts of alkaline earths by a larger amount of soap solution seem to diminish, and, finally, to hinder the formation of such double salts. The fact that highly concentrated neutral solutions of lime salts, mixed with soap, prevent it from frothing without giving an immediate precipitate (first pointed out by Maumené) agrees with this explanation. Boutron and Boudet avoid the above irregularities by applying a more concentrated solution of soap, and a normal volume of 40 c.c. of water. They use a peculiar measuring instrument (hydrotimeter) for reading off the concentrated test-liquid more easily. Its degrees do not correspond with the

cubic centimetres or its fractions. Wilson, who operates under conditions closely resembling those of Clark, obtains regularity of decomposition by adding 4 c.c. of a saturated solution of soda to the normal volume of 100 c.c. of water. In using Clark's process the author adopted the modification of Faisst and Knauss. 45 c.c. of soap solution correspond to 12 milligrms. of lime in 100 c.c. of water. The soap solution for the method of Boutron and Boudet was so arranged that the amount filling 23° of the hydrotimeter exactly sufficed to produce the well-known permanent froth in 40 c.c. of water in which a neutral salt of lime, equivalent to 8·8 milligrms. carbonate of lime has been dissolved. After deducting 1° of soap solution for the formation of froth 22° are employed in decomposing the 8·8 of lime salt in 40 c.c. water. 100 c.c. of the same water contain 22 milligrms. of carbonate of lime. The transformation taken as regular shows 1° soap-liquid to 1 milligrm. carbonate of lime in 100 c.c. of water. If the degrees consumed are multiplied by 0·56 we find the corresponding milligrm. of lime in 100 c.c. of water. The soap-liquid for Wilson's process was so arranged that 36 c.c. corresponded to 12 milligrms. lime in 100 c.c. of water which had been previously mixed with 4 c.c. solution of soda. In case of regular decomposition 3 c.c. solution of soap correspond to 1 milligrm. of lime in 100 c.c. of water. The hardness of a number of natural waters was determined according to these three methods. Some of the results are given below. In these and the following experiments the degrees of hardness are German, *i.e.*, units of lime in 100,000; only in one case, which is specially pointed out, are French degrees employed, *i.e.*, units of carbonate of lime in 100,000 parts of water:—

Total Hardness.

Water.	Clark.	B. and B.	Wilson.
I.	46·75	47·00	—
II.	6·16	6·90	6·20
III.	49·40	50·40	49·33
IV.	31·56	32·70	31·60

Permanent Hardness.

Water.	Clark.	B. and B.	Wilson.
I.	21·52	21·90	—
II.	1·90	1·20	—

The table of Faisst and Knauss was fully confirmed by the author's experiments. The procedure of Boutron and Boudet gives almost always higher numbers than the two other methods. In examining the method of Wilson we find that the addition of a saturated solution of carbonate of soda renders the decomposition of a soap solution by neutral salts perfectly regular. Wilson himself showed this in case of solutions of gypsum; and the author has experimented with a neutral solution of chloride of calcium, obtaining the following numbers:—

Water.	Carbonate of Soda.	Artificial Hardness.	Soap Liquid used.
100 c.c.	4 c.c.	12	36·0 c.c.
		9	27·0
		6	18·1
		3	9·2
		2	6·1
		1	3·3
		0·5	1·9
			0·6

With sulphate of magnesia the results are less favourable. Soap solution acts unequally quickly upon the compounds of the different alkaline earths and those of magnesia. Neutral salts of baryta are more readily decomposed than those of lime, and the latter more readily than magnesian salts. Equivalent quantities of calcium and magnesium compounds require for their decomposition exactly equal quantities of the same soap solution; but its action upon magnesian salts is not only much slower, but, if we do not work with very dilute solutions, incrustations and films are formed which prevent the portion of the magnesian salts still in solution from acting upon the soap. This difficulty is rightly regarded as a flaw in all determinations of hardness by means of soap. It is not very prominent in the method of Clark, nor in that of Boutron and Boudet so long as the normal volume of water is duly diluted with distilled water, and as only small quantities of the soap-liquid are added at once. In Wilson's process it is rendered formidable by the addition of the soda solution. The foam disappears towards the end of the process so slowly that it is doubtful whether the addition of soap-liquid should be continued or not. The hardness of a water rich in magnesian salts is, therefore, easily found too low by Wilson's method, as the following figures show. Three solutions were prepared, the artificial hardness of I. being 20°; of II., 6·5°; of III., 12°. The hardness of No. I. was caused by magnesia alone; that of II., 4·5° by lime and 2° by magnesia; that of III., 9° by lime and 3° by magnesia:—

	Clark.	B. and B.	Wilson.
I.	19·75	21·28	18·33
II.	6·45	6·86	5·66
III.	11·88	12·54	10·80

In case of Wilson's method the foam sometimes disappears after standing 15 to 20 minutes, and cannot be reproduced by shaking. Hence it appears that the original method of Clark is more accurate than either of the others, and is capable of the most general application. *Determination of Magnesia.*—The quantity of magnesian salt existing in solution in a water can be approximately estimated from the difference between the total hardness and the amount of lime as found by Mohr's process (titration with oxalic acid and permanganate), the number obtained being reduced to its equivalent in magnesia by multiplication by $\frac{5}{7}$ths. The error occasioned by free carbonic acid—which also decomposes the soap solution—is neglected. In the author's experiments this amount was very trifling. The method of determining magnesia in a water by soap-liquid, after previous boiling and removal of the lime salts with oxalate of ammonia, cannot be pronounced trustworthy. It yields results which sometimes agree closely with those obtained gravimetrically, but on other occasions differs unaccountably.

Contribution to our Knowledge of the Ashes of Vesuvius.—C. Osterland and P. Wagner.—The sample analysed contained:—

Silica	47·53
Alumina	24·95
Iron (peroxide)	4·90
Iron (protoxide)	3·60
Magnesia	3·33
Lime	12·85
Potash and soda	1·41
Phosphoric acid	0·90
	99·47

Traces of sulphur and sulphuric acid were also present.

Preparation of Iodphosphonium.—A. W. Hofmann.

Phosphines of the Propyl-Butyl and Amyl Series.—A. W. Hofmann.

Formation of Phosphines under Co-Operation of Reduction Processes.—A. W. Hofmann.

Further Observations on the Phosphinic Acids.—A. W. Hofmann.

These four papers are reserved for extended insertion.

On Propylen Diamin.—A. W. Hofmann.—The author prepares propylen diamin by acting with ammonia upon the bromide of propylen in sealed tubes, and afterwards, on the large scale, in an enamelled iron digester. Part of the liquid obtained was filtered from the deposit of bromide of ammonium, and digested with oxide of silver. A strongly alkaline liquid was obtained, in which, after the ammonia and alcohol had been expelled, chloride of platinum gave a pale yellow precipitate, perfectly in-

soluble in water. The rest of the liquid was treated with excess of solid potash, and heated in a retort to expel ammonia and alcohol. Propylen diamin was obtained as an oily liquid. After it had come over, less volatile bases made their appearance, secondary and tertiary diamines and triamines. Pure propylen diamin is a colourless, transparent, not very mobile liquid, boiling at 120° C. It consists of—

Carbon	48·64
Hydrogen	13·52
Nitrogen	37·84
	100·00

And its formula is $C_3H_{10}N_2$. Its affinity for water and for carbonic acid is remarkable.

Certain Carbonic Acid Derivatives of Isobutyl.—E. Mylius.—The compounds described are sulphoethyl-dioxy-carbonate of butyl, sulphobutyl-dioxy-carbonate of ethyl, trisulphocarbonate of butyl, and butyl-trisulphocarbonate of soda.

Action of Chlorine upon Isobutyl Aldehyde.—G. A. Barbaglia.—The author attempted to prepare a monochlorated compound, analagous to Schrœder's monochloro-valeraldehyde, but obtained a substance having the composition C_3H_5ClO, and approaching more nearly to monochloraceton and epichlorhydrine.

Oils of Mustard.—Eugene Dell.—A preliminary notice.

Kresotenic Acid.—R. Biedermann and W. Pike.—The material employed by the authors was cresol, in which sodium was dissolved under simultaneous introduction of a stream of carbonic acid gas. The pure acid obtained fuses at 174° C.; crystallises from hot water in fine shining needles, closely resembling salicylic acid. It takes a deep violet colour on contact with chloride of iron.

Certain Derivatives of Cresol.—R. Biedermann.—The author attempted to obtain substitution products with chlorine, and formed a monochloro-cresol, C_7H_7ClO, fusing at 56° and volatilising undecomposed at 240° C. This substance gives few reactions. It was not found possible to obtain from it orcin or any isomeric body by fusion with potassa or by boiling with alcoholic potassa. Cresol-sulphuric acid was prepared, and its potash-salt fused with potassa gave indications of proto-catechucic acid. The production of orcin was next attempted by means of iodides of cresol. Proper quantities of iodic acid and iodine were dissolved in dilute alkali, and the theoretical amount of cresol was added. A yellowish-red body was ultimately obtained, which, with ammonia, took a red colour like orcin, and dissolved in fixed alkalies with a deep red colour. It did not yield the deep violet colour with perchloride of iron, and the results on analysis did not agree with orcin.

New Members of the Stilben Group.—Julius Strakosch.—This paper gives an account of the preparation and properties of dinitro-stilben, amido-nitro-stilben, and diamido-stilben.

Contribution to the History of the Thio-amides.—R. Wanstrat.—The author has studied the action of iodine upon thio-cuminamide, amidothio-benzamide, and the action of nascent hydrogen upon the product resulting from the treatment of thio-cuminamide with iodine.

Contributions to the History of the Derivatives of Salicylic Acid.—R. Wanstrat.—An account of the preparation and properties of salicylic acid-anilide, salicylic acid-nitranilide, and salicylic acid-toluidide.

Derivatives of Salicyl-Aldehyde.—W. Haarmann.—Salicyl-aldehyde agrees with the remaining aldehydes in its behaviour with substituted ammonia. Salicyl-anilide, $C_{13}H_{11}NO$, has been previously obtained by Schischkoff, with separation of water on heating together equal volumes of aniline and salicyl-aldehyde. The author obtained monobrom-salicylanilide by acting with aniline upon monobrom-salicylaldehyde under the same conditions. It crystallises from alcohol in brick-red needles, and consists of $C_{13}H_{10}BrNO$. Anhydrous hydrocyanic acid reacted violently with a mixture of salicyl-aldehyde and aniline. The result was hydrocyanate of salicyl-anilide, in pure white crystals insoluble in water, but readily soluble in alcohol and ether. On exposure to the air, it becomes light red without decomposition; but if exposed to a continuous heat of 100° C. it is resolved into hydrocyanic acid and a resinoid residue. Its composition is $C_{14}H_{12}N_2O$. Salicyl-paranitranilide is formed by the action of paranitraniline on salicyl-aldehyde. It forms pale yellow crystalline needles, which melt at 115° C. An attempt to combine this body with hydrocyanic acid yielded a bright red substance fusing at 205° C., insoluble in water, and sparingly soluble in boiling alcohol and ether. The action of ammonia and hydrocyanic acid upon salicyl-aldehyde was also examined, the result being a red crystalline body of the composition $C_{29}H_{21}N_3O_3$.

Transformation of Naphthylamine into Nitro-naphthal.—G. Andreoni and R. Biedermann.—A preliminary notice. Naphthylamine is first converted into aceto-naphthylamine. From this mononitro-acetonaphthylamine is obtained, which, by the action of alkalies, becomes mononitro-naphthal.

The Sulphacids of the Methylanilines.—G. A. Smyth.—The author has examined the behaviour of methyl-aniline and dimethylaniline with sulphuric acid. The monosulphacid of dimethylaniline is a crystalline substance of the composition $C_8H_{13}NSO_4$.

New Series of Diamines which Occur as By-Products in the Manufacture of Methylaniline.—A. W. Hofmann and C. A. Martius.

The Violet Colour-Derivatives of the Methyl anilines.—A. W. Hofmann.—These two long and important papers are reserved for full insertion.

Constitution of the Benzol Substances.—Theodore Petersen.—A theoretical, not to say hypothetical, paper, consisting to a great extent of "graphic formulæ."

Aromatic Compounds Containing Silicium.—A. Ladenburg.—The author has formed and examined silicium-phenyl trichloride, ortho-silico-benzoic ether, and silico-benzoic acid, both anhydrous and hydrated.

Derivatives of Cœrulignon.—C. Liebermann.—The author has previously described cœrulignon as a by-product obtained in the purification of wood vinegar, and belonging to the chinon class. He has now investigated the constitution of the substance, and has formed some of its derivatives and reactions.

Constitution of the Allyl Compounds.—A. Kekulé and A. Rinne.—Allyl alcohol is readily attacked by dilute chromic acid. Even in the cold the odour of acrolein is observed, and carbonic acid escapes. If the liquid is distilled, after some time formic acid is detected in the distillate, but not acetic acid. If the same alcohol is treated with nitric acid, there is no odour of acrolein. Formic acid without acetic appears in the distillate, and there is much oxalic acid in the residue. The behaviour of the iodide and cyanide of allyl with chromic and nitric acids was also examined.

On a Compound of the Cyanide of Allyl and Ethylic Alcohol.—A. Rinne.—The new compound consists of C_4H_5N,C_2H_6O. Its boiling-point is between 173° and 174°.

A New Formation of Stilben.—Br. Radziszewski.—Phenyl-acetate of baryta with a slight excess of sulphur was submitted to dry distillation. The distillate contained a hydrocarbon, which, when purified and examined, proved to be stilben. The yield is abundant.

On Graphite.—J. Stingl.—(See p. 264.)

On Ortho-Nitrophenol Sulphacids, Amidophenol Sulphacids, and a new Nitrophenol.—Jul. Post.—A preliminary notice. The author reviews the results of

previous experimentators and announces the discovery of four amido-sulph-phenols.

On Chinon Substances.—Th. Petersen.—A theoretical paper, which would not be intelligible without the accompanying diagrams.

Hydrates of Monobasic Acids.—A. Geuther.—A controversial essay directed against Messrs. Grimaux and Henninger. The author considers that it is not his fault if his results, published three years ago, have not become known to these gentlemen.

Remarks on H. Fudakowsky's Paper "On Slow Oxidation as an Agent for rendering Oxygen Active."—Ed. Schaer.—The author confirms the facts cited by Fudakowski. He states that not alone insulation promotes the slow oxidation of the hydrocarbons and the simultaneous ozonisation of oxygen, but that heat, within certain limits, has the same influence. During a series of experiments performed in the year 1866, with the view of confirming Schœnbein's results on the antozone present in resins, he (Schaer) proved that on carefully distilling, in a place sheltered from direct light, a mixture of water with oil of turpentine, of juniper, of lemon, and other terebenes in a relatively large volume of air, both the distillate and the watery layer of the residual matter give unmistakeable indications of the presence of peroxide of hydrogen; whilst the oil, which has passed over, behaves as if it had been exposed for some time to the action of oxygen under the influence of light. Schœnbein considers this behaviour of the essential oils with oxygen as a main support of his doctrine of the polarisation of oxygen. It may perhaps be assumed—without prejudicing the existence of antozone, so often asserted and so often denied—that the differentiation of oxygen occurs in all cases of slow combustion, that is, whenever air and water act upon organic or inorganic materials.

Derivatives of Bromtoluol as Evidence concerning the Nature of the Bromtoluols.—H. Huebner and P. Hässelbarth.—A table of the formulæ and properties of the parabromtoluol sulphuric, and parabromnitrotoluol sulphuric β and α compounds.

Oxidation Products of Colophonium.—Jos. Schreder.—A preliminary notice. The author is examining the oxidation products of the so-called turpentine-resins, which, unlike the aromatic and the umbelliferous resins, are not attacked and decomposed by melting alkalies, but are oxidised by nitric acid forming acids not yet studied. Colophonium yields isophthalic and trimellitic acids.

Monobasic Saccharate of Lime.—R. Benedikt.—The author has succeeded in preparing a salt, to which he assigns the formula $C_{12}H_{20},CaO_{11}$, and which contains—

Calcium	10·80
Carbon	37·44
Hydrogen	5·57
Oxygen	46·19
	100·00

Diphenyl-benzol.—G. Schultz.—When benzol is passed through incandescent tubes, we obtain along with diphenyl several bodies boiling at higher temperatures. Berthelot has isolated three of these, and distinguished them as—chrysen, benzerythren, and bitumen. The author considers that Berthelot's chrysen is diphenylbenzol, its analysis showing $C_{18}H_{14}$, whilst the formula of chrysen is $C_{18}H_{12}$.

Synthesis of Aromatic Acids.—W. Weith.—The author recently made known that on treating phenylated oil of mustard with powdered copper, cyanphenyl is formed by the removal of sulphur, and passes into its isomer benzonitril. He has subsequently discovered that the above reaction is generally applicable, and that the isomeric tolyl mustard-oils are easily transformed into the corresponding nitriles. In this manner, pseudotoluidine is converted into orthotoluilic acid, and solid toluidine into paratoluilic acid.

Brüning's New Method of Preparing Magenta.—Coupier.—The author claims priority in the preparation of magenta, by treating aniline with nitro-benzol.

A Question of Priority concerning some Thermo-Chemical Laws.—J. Thomsen.—The author considers that Berthelot and others are claiming and receiving the credit of having made certain generalisations which he himself announced several years previously.

Affinity of Oxygen for Chlorine, Bromine, and Iodine.—J. Thomsen.—An examination of the amount of heat liberated during the formation of chloric, bromic, iodic, hypochlorous, and periodic acids.

New Universal Support.—R. Muencke.—The construction and uses of this piece of apparatus could not be understood without the accompanying illustration.

New Conversion of Oil of Turpentine into Cymol.—A. Kekulé.—Iodine was added to the oil of turpentine-oil in small successive portions, the reaction being each time assisted towards the end of heat before a fresh quantity was added. In this manner 10 grms. of cymol were obtained from 50 grms. oil of turpentine and 22 grms. of iodine.

Bulletin de la Société Chimique de Paris, tome xix., No. 10, May 20, 1873.

Binitro Compounds of the Higher Homologues of Benzol.—A. Rommier.—In his previous investigations, the author obtained from the oils of coal two xylenes, one of which was soluble in sulphuric acid of ordinary concentration, and the other insoluble. The soluble xylene yielded, with fuming nitric acid, two binitro compounds, the mixture of which melted at 61° C. These two bodies, re-crystallised from alcohol, have been investigated by Des Cloizeaux, who found that the less soluble binitro-xylene, α, formed crystals belonging to the clino-rhombic system, whilst the more soluble binitro-xylene, β, formed rhombic crystals of the triclinic system. On further examination it was, however, found that the salt β, on repeated crystallisation, was transformed into α. The author concludes, therefore, that there is merely a single binitro compound corresponding to the xylene soluble in sulphuric acid. To sum up: by the action of ordinary sulphuric acid upon the oils of coal, we separate two xylenes, two cumenes, and two cymenes:—I. Hydrocarbides insoluble in sulphuric acid, accompanied by a certain quantity of formenic hydrides. (1). Xylene, boiling between 139° and 140°; its binitro compound melts at 92°, and forms clino-rhombic crystals. It differs from the binitro methyl-toluen of Fittig, which forms two kinds of crystals, the less soluble in long colourless needles, melting at 123·5°, the other in brilliant, transparent, monoclinic crystals, fusible at 93°. (2). Mesitylene, boiling at 165° to 167°, is the most abundant member of the series; its presence in coal oils was shown by Fittig, and its binitro compound examined by Des Cloizeaux. (3). Cymene, according to theory, should boil at 196°, the gradation of boiling-points between benzol and its homologues being 28° to 29°. Its direct verification did not succeed, from the presence of formenic hydrides boiling at adjacent temperatures. II. Hydrocarbides soluble in sulphuric acid and regenerated by distillation. (1). Isoxylene, boiling at 139° to 140°. Its binitro compound melts at 92° to 93°; very fragile prisms. (2). Pseudocumene, boiling at 165° to 167°, and forming two binitrocumenes fusible at 86°. (3). The cymene of this series is contaminated with naphthaline.

On Aniline Black.—Ch. Lauth.—(See p. 275).

Reply to the last Communication by M. Berthelot on the Mercurial Calorimeter.—P. A. Favre.—A continuation of the controversy between these two *savants* (see vol. xviii., p. 388).

On Silk Dyeing, and on the Combination of Silk with Sulphuric Acid.—M. E. Durrwell.—The author takes, for the foundation of his views, the hypothesis that silk forms, with acids, true compounds, capable of uniting with the coal-tar colours and with other dyes. Having ungummed silk to set the fibroine at liberty, he boiled it for a day in distilled water, to remove the last traces of the soap employed in this operation. It was then extracted with alcohol, so as to leave pure fibroine, which invariably gave an alkaline reaction. This silk was then dyed in a bath of litmus and very dilute sulphuric acid. The litmus serves here at once as reagent and as colouring matter. The colour is thus entirely fixed in the silk; but, on neutralising the bath with a trace of magnesia or of caustic soda, the blue litmus went back into solution, except a trace which was still absorbed by the silk. This experiment may be indefinitely repeated on the same colour-bath by rendering it alternately acid or neutral. It is the same with the coal-tar colours, but, as these have a great tinctorial power, the experiment is less striking and decisive than with litmus. On treating 2 parts of fibroine with 1 part of sulphuric acid in the cold, combination at once takes place. Heat is developed, which must be kept down as much as possible by cooling the capsule, otherwise the silk will be completely resolved into glucose and ulmic compounds. After an hour's time, the reaction is complete. The brown liquid is filtered over asbestos, diluted with three or four times its bulk of water; the excess of acid is neutralised with baryta, filtered, and evaporated. A mass is thus obtained which, on treatment with alcohol, leaves a true compound of fibroine and of sulphuric acid. It is a white, transparent, horn-like body, soluble in water. The solution, if treated with an alkali, gives a precipitate of fibroine.

Bulletin de l'Academie Royale des Sciences des Lettres et des Beaux-Arts de Belgique, No. 4, 1873.

Note on a Fossil Bird discovered in the Rupel Clay.—P. J. van Beneden.

New Process for Preventing Ships' Compasses being affected by the Iron and Steel which is employed in the construction, as well as occasionally carried as cargo by the vessels.—M. Glœssner.

Revue Scientifique de la France et de l'Etranger, No. 47, May 24, 1873.

This number contains no original chemical matter.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 19, March 13, 1873.

Delaunay's Apparatus for the Alcoholometric Assay of Wines.—The specific gravity of the wine is taken in its ordinary state. Another equal portion of wine is boiled in a flask till all the alcohol is expelled and the thermometer immersed in it rises to 100° C. The boiled liquid is then put into the hydrometer glass, made up to its original bulk with distilled water, and its specific gravity again determined. From the difference of these two specific gravities (before and after the expulsion of the alcohol) the amount of alcohol is found by means of tables accompanying the apparatus. It is necessary that the temperature of the wine should be 15° C. If it be higher or lower corrections are required.

No. 20, March 20, 1873.

This number contains nothing touching in the remotest manner upon chemistry.

No. 21, March 27, 1873.

Galzy's Insecticide.—A laudatory notice of an insecticide of unknown origin.

New Mode of Preserving Organic Substances from Decay.—M. Lanjorrois.—The author proposes to add to the substances to be preserved 1 per cent of magenta! The process has been applied to slices of beef, which, after being kept for several months, yielded—after being washed and boiled—very good soup. (Should this method of preserving food become general, we trust that the magenta employed will be free from arsenic).

MISCELLANEOUS.

Memorial to Justus Liebig.—Many of our readers will be glad to know that at a meeting of the German Chemical Society, held in Berlin, on April 28th last, it was resolved to erect a statue in honour of the late illustrious chemist, Baron Liebig, and to invite his pupils, friends, and chemists of all nations, to contribute towards the funds necessary for that object. Drs. Warren de la Rue, Frankland, Gilbert, Odling, Stenhouse, and Williamson, are members of the Committee, and communications and subscriptions may be sent to Dr. Hugo Müller, 110, Bunhill Row, E.C.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the means of and apparatus for removing obstructions from gas-pipes. George Goldsmith and James Dilkes, Leicester. November 4, 1872.—No. 3269. The object of this invention is to afford means for clearing gas-pipes, especially services, and consists in forming a plug furnished with a barrel which is to be filled with gunpowder and inserted in the offending pipe. The charge is then to be fired by striking a percussion-cap placed on a nipple on the outside of the plug, when an explosion ensues and the removal of any obstruction is the result.

The manufacture from mahogany and other woods of a colouring matter similar to cashoo. Charles Rave, merchant, Cureghem-les-Bruxelles, Belgium. November 4, 1872.—No. 3270. This invention consists in extracting from mahogany and rose woods a matter having all the properties of the brown cashoo of commerce. The matter is obtained by first reducing the wood to powder, then roasting or torrefying the powder, afterwards washing and boiling it, and finally concentrating it by evaporation into a syrupy or a dry state.

Improvements in cements. John Railton Williams, merchant, Manchester, Lancaster. November 4, 1872.—No. 3272. This invention consists in mixing powdered zinc with cement.

Improvements in obtaining anthracene and in apparatus connected therewith. John Berger Spence, merchant, Manchester, Lancaster. (A communication from Jos. C. F. Cheever, New York, United States of America). November 4, 1872.—No. 3273. This invention consists of a pitch tank, tempering reservoir, still, and condensor, for the purpose of obtaining anthracene from coal-tar pitch by a continuous process.

Improvements in treating and utilising certain refuse animal and vegetable substances, and the application of the resulting substances or matters to various manufactures. William Glazier, 235, Drake Street, Rochdale, Lancaster. November 5, 1872.—No. 3278. This invention consists in utilising scrap leather and the fibrous refuse from wool, cotton, flax, and jute manufactures and spent dye-woods by combining these materials with silicates, animal carbon, gas-tar, asphalt, and bitumen in the several ways described in the Specification so as to make an improved plastic composition and also various kinds of waterproof and fireproof goods and vessels. The leather is first treated with a hot solution of alkali, and then subjected to the action of steam or boiled in water under pressure until it is reduced to a gelatinous mass, to which is added glycerine and pyroligneous acid. To this mixture is added a solution of pyroligneous acid and tannic acid or of pyroligneous acid and alum. The whole is then thinned with boiled oil and mixed with mineral oxide, or dry silicate colours. This mixture is called the "cementing mixture." By adding to this mixture the fibres hereinbefore referred to, a plastic composition or pulp is made, which may be rolled, moulded, or otherwise formed into various useful and ornamental articles. In making "shaped" felted articles the fibres are first disintegrated or devilled, then deposited on moulds and the shapes saturated with the cementing mixture. In making composite sheets or slabs the devilled fibres are felted into sheets, which sheets are saturated with the cementing composition, then coated with the plastic composition. The whole is then pressed, after which, should the slab not be sufficiently thick, other saturated sheets are placed on the first until the slab is made of the required thickness. In making waterproof slabs or sheets the felted sheets are saturated, as before described, pressed, and dried; then coated with a waterproofing composition of ground carbon and gas-tar mixed with naphtha or turpentine or benzine, and are covered with melted asphalt or bitumen, on which a second prepared sheet is placed and the whole

pressed together. The waterproofing composition above described is applicable to the protection of iron from rust and also to the coating of vessels and articles made according to this invention. In making floor-cloth the "cementing composition" is mixed with silicate pigments, cotton fibres, spent dyewoods, and ground cork and spread on the felt. In making tesselated floor-cloth or imitation parquetry the sheets of felt are saturated with the cementing composition and coloured according to the pattern required. The pieces constituting such pattern are then cut out and affixed to a sheet of felt or canvass by means of the cementing composition. In making circular and other shaped receptacles, tubs, "skips," boxes, tanks, and cisterns, a shape is made by cementing brown paper on a suitable mould. The shape is then coated with the cementing composition and when dry coated with the plastic composition hereinbefore described, after which it is again dried and pressed and finished by coating with the waterproof composition. Where great strength is required, strips of calico are affixed around the vessel. The waterproofing and cementing compositions hereinbefore described are applicable to the preservation of iron ships.

Improvements in artificial fuel, part of which improvements having reference to the means or apparatus employed in the manufacture of the same. Edward Joseph William Parnacott, engineer, Leeds. November 6, 1872.—No. 3292. The employment of powdered, dissolved, or liquefied waste caoutchouc or gutta-percha for fuel either separately or in combination with other substances such as clay, road mud, fine riddlings or small coal or dust of coke, also shale, peat, and sawdust; these are thoroughly mixed or agglomerated in a pug-mill, and afterwards moulded into any required form in a brick-machine of ordinary construction, and afterwards dried.

NOTES AND QUERIES.

Formic Acid.—Will any of your readers inform me whether commercial formic acid, formiate of lead, or any other formiate is used for dyeing or any other process in the arts ?—S. S.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 43.—"The torsion-rod is never at absolute rest, but is constantly in a state of vibration on its centre; and consequently when the end of it is viewed at a distance with the telescope, it appears to oscillate on each side of a mean point, called the *resting point*."

"This resting point, however, is by no means permanent or stationary, and seldom remains in the same position for any length of time, even when the torsion-rod is not influenced by the approach of the masses. The extent and direction of its disturbance, as well as its rate of motion when so disturbed, are very variable, and seem to depend on causes which have not been sufficiently accounted for, but which may in some measure arise either from slight changes of temperature, or some latent alteration in the component parts of the suspension line."

P. 44.—" . . . It must be confessed, however, that discordances sometimes arise which cannot wholly be attributed to change of temperature, but to some other occult influence with which we are at present unacquainted."

P. 64.—"Seeing that the results came out nearly the same, with the same balls, in whatever way the experiments were varied, I next tried the same plan with the glass balls, the single results of which . . . . . had been somewhat more discordant, and the mean result somewhat greater, than the results obtained by the other balls. . . . . I was agreeably surprised at finding the single and daily results in such good accordance with each other, ... although I was still at a loss to account for the slight difference which still existed between the results with these balls and the heavier ones."

"I next tried what the result would be with balls made of a substance still lighter than that of glass. I therefore . . . . affixed the 2 inch ivory balls. . . . . . the mean result agrees very well with the general result of the experiments previously made with the 2 inch lead balls; although it is somewhat less than that deduced from the experiments made with the glass balls, which was contrary to my expectations."

P. 65.—"Conceiving that there might be some unexplained cause even for this slight discordance, I resolved to repeat the experiments under the same circumstances. . . . . The mean result was still less than in the former series. I am unable to account for the cause of this discordance in any other way than by the known fact that in all cases, where the deviation is so small, ... a slight variation in the position of the resting point makes a considerable difference in the resulting density. . . . . But, in the present instance, the single and daily results are in very good accordance with each other. . . . Some other varying force, therefore, would seem to be in operation.

"Wishing however to ascertain whether a similar diminished result would be produced by a repetition of the experiments with the glass balls, I again submitted them to another trial. . . . . the mean result showed that the same diminished difference had here also been produced as . . . . with the ivory balls; and for the cause of which I cannot account in any other way than that to which I have just alluded."

P. 67.—"I am still however unable to assign any satisfactory reason why the mean result of these heavy balls should be so much less than that of the lighter balls. There is nothing on the face of the experiments that indicates any cause for a suspicion of error, and therefore we must look for some other explanation."

MEETINGS FOR THE WEEK.

Monday, 9th.—Geographical, 8.30.
Tuesday, 10th.—Photographic, 8.
Wednesday, 11th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 12th.—Royal, 8.30.
—— Royal Society Club, 6.
Friday, 13th.—Astronomical, 8.
Saturday, 14th.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

⁂ Vol. XXVI. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

D. McPherson.—See No. 683.

W. B. M.—Received with thanks.

BOOKS RECEIVED.

Manual of Chemical Analysis as Applied to the Examination of Medicinal Chemicals. By Frederick Hoffmann, Ph.D.—New York: D. Appleton and Co.

Practical Examples in Quantitative Analysis. By Ernest Francis, F.C.S.—London: H. R. Lewis.

Notes of a Course of Nineteen Lectures on Natural Philosophy. By G. F. Rodwell, F.R.A.S., F.C.S.—J. and A. Churchill.

Third and Fourth Annual Reports of the Geological Survey of Indiana, made during 1871 and 1872 by E. T. Cox.—Indianapolis: R. J. Bright.

Maps for Geological Survey of Indiana, 1872. By E. T. Cox.

THE CHEMICAL NEWS.

VOL. XXVII. No. 707.

ON THE ACTION OF HYDROCHLORIC ACID ON CODEINE.

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

IN a former paper, written in conjunction with E. L. Mayer (*Chem. Soc. Journ.*, [2] xi., 211), it has been shown that when morphine is treated with hydrochloric acid at 100° the first action that takes place is, apparently, the addition of the elements of hydrochloric acid; the subtraction of the elements of water taking place subsequently, bases being formed of the composition—

$$(\overline{M} = C_{34}H_{36}N_2O_5)$$
$$(P).\ \overline{M} + HCl$$
$$(Q).\ \overline{M} + HCl - H_2O$$
$$(R).\ \overline{M} + 2HCl - 2H_2O$$

A base homologous with the last one has been obtained already from codeine, viz., the so-called "chlorocodide" obtained by the late A. Matthiesen and the author (*Proc. Roy. Soc.*, xviii., 83). In order to trace out more completely the history of the formation of this base and its subsequent decompositions, codeine was heated on the water-bath for two and a half hours with from 6 to 8 parts of strong hydrochloric acid; a less time of digestion being found to give too little product for successful isolation. The resulting acid liquid was nearly neutralised by caustic soda, and precipitated by sodium carbonate, which threw down a white amorphous precipitate; this was separated by filtration, dissolved in hydrochloric acid, again precipitated by sodium carbonate to remove traces of codeine, and finally dissolved in ether. The ethereal solution yielded a viscid non-crystalline hydrochloride on agitation with a few drops of hydrochloric acid. In physical properties this exactly resembled "chlorocodide" hydrochloride: but on analysis it yielded numbers indicating the presence of a less chlorinated base as well—

0·3005 grm. gave 0·673 CO_2, and 0·166 H_2O
0·3165 ,, ,, 0·229 AgCl.

These numbers agree with the composition—

$$9(C_{36}H_{42}N_2O_6,2HCl) + 14HCl - 10H_2O;$$

which represents a mixture of the hydrochlorides of two bases homologous with (P) and (R) derived from morphine as above mentioned—

	Calculated for $\{4C_{36}H_{43}ClN_2O_6,2HCl;\ 5C_{36}H_{40}Cl_2N_2O_4,2HCl\}$	Found.
Carbon	61·04	61·08
Hydrogen	6·12	6·14
Chlorine	17·83	17·90

Hence, writing $\overline{C}$ for $C_{36}H_{42}N_2O_6$, the formation of these bases may be expressed thus:—

$$\overline{C} + 3HCl = \underbrace{(\overline{C} + HCl)}_{\text{Homologue of (P) from Morphine.}},2HCl$$

$$\overline{C} + 4HCl - 2H_2O = \underbrace{(\overline{C} + 2HCl - 2H_2O)}_{\text{Chlorocodide.}},2HCl$$

It thus appears that the formation of "chlorocodide" is preceded by that of a base containing only 1 proportion of chlorine to 36 of carbon, and, hence, "chlorocodide" must be represented by a C_{36} formula at least; but as ordinary codeine is obtained from "chlorocodide" by the action of water (Matthiesen and Wright, *Proc. Roy. Soc.*, xviii., 83), it appears that "chlorocodide" is a derivative of ordinary codeine and not of any of its higher polymerides, and hence that ordinary codeine must have a C_{36} formula too.

When the action of hydrochloric acid at 100°, or slightly higher, (the liquid being kept *very* gently boiling) is carried on for a longer time methyl chloride is evolved; but after a time this ceases, and after 10 hours or so all the codeine has become converted into a mixture of two isomeric bases of composition intermediate between that of morphine and that of "apomorphine." One of these bases is soluble in ether, and yields crystalline salts much resembling those of apomorphine; the other is insoluble in ether, and belongs apparently to the tetra series.

The product of 10 hours' action of hydrochloric acid was precipitated by sodium carbonate, well drained on filters, and digested with ether. The ethereal solution agitated with hydrochloric acid gave a crystalline hydrochloride, which gave the following numbers after recrystallisation:—

0·3065 grm. gave 0·7380 CO_2 (H_2O lost).
0·2255 ,, ,, 0·5350 CO_2 and 0·132 H_2O.
0·1015 ,, ,, 0·0480 AgCl.

	Calculated.		Found.	
C_{68}	816	65·28	65·65	64·71
H_{76}	76	6·08	—	6·50
Cl_4	142	11·36	11·69	
N_4	56	4·48		
O_{10}	160	12·80		
$C_{68}H_{72}N_4O_{10},4HCl$	1250	100·00		

The portion insoluble in ether was dissolved in hydrochloric acid, and fractionally precipitated by sodium carbonate to remove colouring matters. Finally a non-crystalline hydrochloride was obtained which gave the following numbers after drying at 100°:—

0·2980 grm. gave 0·716 CO_2, and 0·170 H_2O.
0·2980 ,, ,, 0·1365 AgCl.

	Calculated.		Found.
C_{136}	1632	65·28	65·52
H_{152}	152	6·08	6·34
Cl_8	384	11·36	11·33
N_8	112	4·48	
O_{20}	320	12·80	
$C_{136}H_{144}N_8O_{20},8HCl$	2500	100·00	

From its physical properties it appears probable that ths base forming the crystalline hydrochloride belongs to the series of derivatives from the *double* polymerides (dicodeine, "apomorphine," &c.); hence it is viewed as having a C_{68} formula, and as possessed of the composition of the "diapo" derivative of (hypothetical) dimorphine, *i.e.*, as $\overline{M}_2 - 2H_2O$. Hence it may be conveniently termed *diapo-dimorphine*.

Similarly, the isomeric base insoluble in ether produced simultaneously evidently belongs to the tetra series, and hence may be conveniently termed *tetrapo-tetramorphine*, having the composition $\overline{M}_4 - 4H_2O$, and a C_{136} formula.

Both compounds give a blood-red colouration with nitric acid, a lighter evanescent red with sulphuric acid and potassium dichromate, and a dirty purple with ferric chloride. They may be viewed as produced by the mutual reaction, polymerisation, and demethylisation of the two bases first formed by the action of hydrochloric acid on codeine, viz., the homologues of (P) and (R) similarly obtained from morphine.

$$\underbrace{(\overline{C} + HCl)}_{\text{Homologue of P.}} + \underbrace{(\overline{C} + 2HCl - 2H_2O)}_{\text{"Chlorocodide."}} + HCl =$$
$$= 4CH_3Cl + \underbrace{(\overline{M}_2 - 2H_2O)}_{\text{Diapodimorphine.}}$$

$$\underbrace{2(\bar{C}+HCl)}_{\text{Homologue of P.}} + \underbrace{2(\bar{C}+2HCl-2H_2O)}_{\text{"Chlorocodide."}}+2HCl=$$
$$=8CH_3Cl + \underbrace{(\bar{M}_4-4H_2O)}_{\text{Tetrapotetramorphine.}}$$

where $\bar{C}=\bar{M}+2CH_2=\bar{M}+2CH_3-H_2$, *i.e.*, where codeine is dimethylated morphine.

It has been formerly shown* by the late A. Matthiesen and the writer that when either "chlorocodide" or codeine is heated to 140° to 150° under pressure with excess of strong hydrochloric acid methyl chloride is formed, and apomorphine apparently identical with that from morphine is produced. It thus appears that the action of hydrochloric acid on codeine at 100° is different from that at 140° to 150°, the elements of two proportions of water (per C_{68}) being removed in the first case, and those of four proportions in the second, diapodimorphine, and tetrapodimorphine being respectively formed. These two bodies are alike in physical properties and qualitative reactions, but they differ much in physiological properties. Dr. Gee found that the latter produced the same emetic action as apomorphine from morphine; whilst the experiments of Dr. J. G. Blackley prove that the former base is destitute of emetic action on cats, only producing profuse salivation when subcutaneously injected in doses up to 0·1 grm.

It hence appears that the removal of the elements of water from (hypothetical) dimorphine, and from tetramorphine respectively, gives rise to an alteration in the physiological properties of the derivatives, the emetic action on cats being the *more* marked in the first case the more H_2O is removed, the *less* so in the second case. Thus the following table exhibits the change in physiological action :—

Name of Base.	Relation to Morphine.	Physiological Action.	Observer.
		Di Series.	
Dimorphine.	$\bar{M}_2$.	(?)	—
Diapodimorphine.	$\bar{M}_2-2H_2O$.	Produces profuse salivation, but no vomiting (cats).	Dr. J. G. Blackley.
Tetrapodimorphine.	$\bar{M}_2-4H_2O$.	Moderately powerful emetic (cats). Very powerful emetic (man).	Drs. Gee and Stocker.
		Tetra Series.	
Tetramorphine.	$\bar{M}_4$.	Very powerful emetic (cats).	Dr. Stocker.
Diapotetramorphine.	$\bar{M}_4-2H_2O$.	Do. do. (cats and dogs).	Do.
Tetrapotetramorphine.	$\bar{M}_4-4H_2O$.	Produces profuse salivation, but no vomiting (cats).	Dr. J. G. Blackley.
Octapotetramorphine.	$\bar{M}_4-8H_2O$.	Neither salivation nor vomiting produced (cats).	Do.

Action of Hydrobromic Acid on Codeine.

The results just detailed render it probable that the formation of "bromocodide" is preceded by that of a less brominated base probably $(\bar{C}+HBr),2HBr$, which appears, in fact, to be the case.

On heating codeine to 100° for three hours with 5 to 6 parts of 48 per cent hydrobromic acid, precipitating with sodium carbonate, solution of precipitate in ether, and agitation of ethereal solution with hydrobromic acid, a viscid non-crystalline hydrobromide is obtained, much resembling bromocodide hydrobromide, but containing less bromine.

After drying at 100°, the gum-like mass gave these numbers—

0·3410 grm. gave 0·6310 CO_2 and 0·158 H_2O.
0·3000 ,, ,, 0·2205 AgBr.

These numbers agree with the composition—

$$2(\bar{C}+HBr),2HBr+\underbrace{(\bar{C}+2HBr-2H_2O),2HBr}_{\text{Bromocodide.}}$$

	Calculated.	Found.
Carbon ..	50·47	50·47
Hydrogen..	5·14	5·15
Bromine ..	31·15	31·27

Whence it appears that the first action of hydrobromic acid on codeine is perfectly parallel with that of hydrochloric acid; it has already been shown, however (*Proc. Roy. Soc.*, xix., 371, 504), that the further action of hydrobromic acid gives rise to products not identical with those formed by means of hydrochloric acid whether acting at 100° or at higher temperatures.

From its physical properties, it appears probable that the "deoxycodeine" thus formed belongs to the dicodeine series, *i.e.*, its formula contains C_{72}; whilst the "bromotetracodeine" simultaneously produced is a tetra base, *i.e.*, its formula contains C_{144}: the formation of these two bases may, then, be explained by the following equation :—

$$8(\bar{C}+HBr)2HBr+2\underbrace{(\bar{C}+2HBr-2H_2O),2HBr}_{\text{Bromocodide.}}=8HBr+$$
$$+\underbrace{(\bar{C}_2+H_8-4H_2O)}_{\text{Deoxycodeine.}},4HBr+2\underbrace{(\bar{C}_4-H_4+2HBr)}_{\text{Bromotetracodeine.}},8HBr.$$

This reaction is different from that formerly given (*loc. cit.*), where the action was supposed to consist, at any rate partly, in the replacement of bromine by hydroxyl; it now appears more probable that this replacement does not take place, the hydroxyl group being subtracted from a portion of the formula different from that to which the bromine symbol is added.

The table on next page represents the relation to codeine and morphine of the derivatives obtained up to this time from codeine;* inasmuch as the "apomorphine" obtained from codeine by the action of hydrochloric acid at 140° to 150° appears to be identical with that derived from morphine under the same or other conditions, whilst the bases obtained by the action of hydriodic acid and phosphorus from codeine and morphine appear to be identical also, the conclusion may be drawn that codeine is actually dimethylated morphine, *i.e.*, $\bar{C}=\bar{M}+2CH_3-H_2$.

All these derivatives may be regarded as formed by the addition of the elements of *m* proportions of hydriodic, hydrochloric, or hydrobromic acid to, and the subtraction of *n* proportions of water from, a polymeride either of codeine or of morphine, or a base derived from one or other of these by the addition or subtraction of hydrogen; in short, all of these derivatives (together with those obtained from morphine as starting-point, and tabulated in a previous paper [*Journ. Chem. Soc.*, II., xi., 211]) may be included in one or other of the two formulæ—

$$(\bar{C}\pm H_p)x+mHX-nH_2O$$
$$(\bar{M}\pm H_p)x+mHX-nH_2O$$

* *Proc. Roy. Soc.*, xvii., 460; xviii., 83.

* Matthiessen and Wright, *Proc. Roy. Soc.*, xvii., 460; xviii., 83. Wright, *ibid.*, xix., 371, 504; xx., 8, 278.

DERIVATIVES CONTAINING xC_{36} (CODEINE SERIES).

Mono Series.

Name.	Formula.	Origin.	Relation to Codeine.
Codeine.	$C_{36}H_{42}N_2O_6$.	—	$\overline{C}$.
—	$C_{36}H_{43}ClN_2O_6$.	Codeine and HCl.	$\overline{C}+HCl$.
Chlorocodide.	$C_{36}H_{40}Cl_2N_2O_4$.	Do. do.	$\overline{C}+2HCl-2H_2O$.
—	$C_{36}H_{43}BrN_2O_6$.	Do. and HBr.	$\overline{C}+HBr$.
Bromocodide.	$C_{36}H_{40}Br_2N_2O_4$.	Do. do.	$\overline{C}+2HBr-2H_2O$.

Di Series.

Dicodeine.	$C_{72}H_{84}N_4O_{12}$.	Codeine and H_3PO_4. / Do. and H_2SO_4.	$\overline{C}_2$.
—	$C_{72}H_{83}ClN_4O_{11}$.	Dicodeine and HCl.	$\overline{C}_2+HCl-H_2O$.

Tri Series.

Tricodeine.	$C_{108}H_{126}N_6O_{18}$.	Codeine and H_2SO_4.	$\overline{C}_3$.
—	$C_{108}H_{114}N_6O_{12}$.	Tricodeine and HCl.	$\overline{C}_3-6H_2O$.

Tetra Series.

Tetracodeine.	$C_{144}H_{168}N_8O_{24}$.	Codeine and H_3PO_4. / Do. and H_2SO_4. / Dicodeine and H_2SO_4.	$\overline{C}_4$.

DERIVATIVES FROM BASES MORE HYDROGENISED THAN CODEINE.

$(\overline{C}+H_4)_2$ *Series.*

Deoxycodeine.	$C_{72}H_{84}N_4O_8$.	Codeine and HBr.	$(\overline{C}+H_4)_2-4H_2O$.

DERIVATIVES FROM BASES LESS HYDROGENISED THAN CODEINE.

$(\overline{C}-H)_4$ *Series.*

Bromotetracodeine.	$C_{144}H_{166}Br_2N_8O_{24}$.	Codeine and HBr.	$(\overline{C}-H)_4+2HBr$.
Chlorotetracodeine.	$C_{144}H_{166}Cl_2N_8O_{24}$.	Bromotetracodeine and HCl.	$(\overline{C}-H)_4+2HCl$.

DERIVATIVES CONTAINING xC_{34} (MORPHINE SERIES OF BASES DERIVED FROM CODEINE AS STARTING-POINT.)

Di Series.

Apomorphine. (Tetrapodimorphine).	$C_{68}H_{68}N_4O_8$.	Codeine and HCl at 150°. / Chlorocodide and do.	$\overline{M}_2-4H_2O$.
Diapodimorphine.	$C_{68}H_{72}N_4O_{10}$.	Codeine and HCl at 100°.	$\overline{M}_2-H_2O$.

Tetra Series.

Tetrapotetramorphine.	$C_{136}H_{144}N_8O_{20}$.	Codeine and HCl at 100°.	$\overline{M}_4-4H_2O$.

DERIVATIVES FROM BASES MORE HYDROGENISED THAN MORPHINE.

$(M+H_4)_2$ *Series.*

Deoxymorphine.	$C_{68}H_{76}N_4O_8$.	Codeine and HBr. / Bromocodide and HBr.	$(\overline{M}+H_4)_2-4H_2O$.

$(\overline{M}+H_2)_4$ *Series.*

—	$C_{136}H_{153}IN_8O_{20}$.	Dicodeine, HI, and P.	$(\overline{M}+H_2)_4+HI-4H_2O$.

$(\overline{M}+H_4)_4$ *Series.*

—	$C_{136}H_{172}I_4N_8O_{24}$.	Codeine, HI, and P at 100°.	$(\overline{M}+H_4)_4+4HI$.
—	$C_{136}H_{164}I_4N_8O_{20}$.	Do. do. at 115°.	$(\overline{M}+H_4)_4+4HI-4H_2O$.
—	$C_{136}H_{162}I_2N_8O_{20}$.	Preceding, treated with water.	$(\overline{M}+H_4)_4+2HI-4H_2O$.
—	$C_{136}H_{161}IN_8O_{20}$.	Do. do.	$(\overline{M}+H_4)_4+HI-4H_2O$.
—	$C_{136}H_{160}N_8O_{20}$.	Do. do.	$(\overline{M}+H_4)_4-4H_2O$.

$(M+H_8)_4$ *Series.*

—	$C_{136}H_{164}I_4N_1O_{12}$.	Codeine, HI, and P at 135°.	$(\overline{M}+H_8)_4+4HI-12H_2O$.
—	$C_{136}H_{176}N_8O_{20}$.	Preceding and water.	$(\overline{M}+H_8)_4-4H_2O$.
—	$C_{136}H_{178}I_2N_8O_{20}$.	Do. and HI.	$(\overline{M}+H_8)_4+2HI-4H_2O$.

DERIVATIVES FROM BASES LESS HYDROGENISED THAN MORPHINE.

$(\overline{M}-H)_4$ *Series.*

Bromotetramorphine.	$C_{136}H_{150}Br_2N_8O_{24}$.	Codeine and HBr. / Bromocodide and HBr.	$(\overline{M}-H)_4+2HBr$.
Chlorotetramorphine.	$C_{136}H_{150}Cl_2N_8O_{21}$.	Bromotetramorphine and HCl.	$(\overline{M}-H)_4+2HCl$.

Where p varies from 0 to 8,

x = 1, 2, 3, or 4 (giving rise to the mono, di, tri, and tetra series respectively;

m varies from 0 to 4;

X is either Br, I, or Cl;

n varies from 0 to 12.

In many instances the bases thus produced from codeine and morphine (some forty in number) have not been named, the complexity of their composition, and the scanty knowledge as yet possessed of their relations to other substances precluding the possibility of a systematic nomenclature; where names have been given from motives of convenience in reference, the chief point aimed at was to indicate the nature of the relation of the derivative to the parent base; thus, the name "diapotetramorphine" indicates that the formula of the base is obtained from that of the "tetra" polymeride of morphine by the subtraction of the elements of two proportions of water, *i.e.*, that the composition is indicated by the expression—

$$\overline{M}_4 - 2H_2O.$$

Objections may be raised to the use of the prefix "apo," to indicate the removal of the elements of water, on the ground that there is no reference to *water* in the etymology of the term; but the prefix "anhydro" is open to the more serious objection that it really indicates the contrary of the prefix "hydro," which refers to the addition, *not of the elements of water, but of hydrogen* (hydroquinone, hydrocyanic acid, hydrocinnamic acid, &c., &c.); whilst the prefix "meta," which has been used in the sense in which "apo" has been employed during these researches (Barker, *Am. Journ. Sci.*, vol. xliv., Nov., 1867), is also used to indicate a particular class of benzene derivatives, which are in no way producible from the parent body by the removal of the elements of water. The inconvenience and ambiguity occasioned by the inconsistent meanings thus attachable to the terms "anhydro" and "meta" are such as to warrant the invention of a new term when precision in language is desired.

Each one of the bases mentioned in the following table form a hydrochloride (hydrobromide or hydriodide) containing as many proportions of hydrochloric (hydrobromic or hydriodic) acid as there are nitrogen symbols in the formula.

Three other compounds, not included in the foregoing tables, have also been obtained, viz.:—

Chloro-dicodeine-dimorphine-hydrochloride—

$$C_{140}H_{158}Cl_2N_8O_{24},8HCl,$$

which is homologous with, and intermediate between, chloro-tetracodeine and chloro-tetramorphine hydrochlorides. Also the compounds $C_{136}H_{214}I_6N_8O_{44},8HI$ and $C_{136}H_{206}I_6N_8O_{32},8HI$, obtained by the action of hydriodic acid on the compounds $(\overline{M}+H_4)_4-4H_2O$ and $(\overline{M}+H_4)_4+4HI$, respectively.

These two latter derivatives may be represented by the formulæ—

$$(\overline{M}+H_4)_4+6HI+20H_2O$$

and— $$(\overline{M}+H_8)_4+6HI+8H_2O,$$

differing from all the other derivatives of $(\overline{M}+H_4)_4$ and $(M+H_8)_4$ in that the elements of water are added on, instead of being subtracted, while the elements of six proportions of hydriodic acid are also added on, four being the highest number in the other cases.

Royal Society.—At a meeting held last night the following gentlemen were elected Fellows of the Royal Society:—William Aitken, M.D.; Sir Alexander Armstrong, M.D.; Robert Stawell Ball, LL.D.; John Beddoe, B.A., M.D.; Frederic Joseph Bramwell, C.E.; Staff-Captain Edward Kilwick Calver, R.N.; Robert Lewis John Ellery; Lieut.-Colonel James Augustus Grant, C.B., C.S.I.; Clements Robert Markham, C.B.; George Edward Paget, M.D., D.C.L., LL.D.; George West Royston Pigott, M.A., M.D.; Osbert Salvin; Hon. John William Strutt; Henry Woodward; James Young.

AFFINITY OF HYDROGEN TO THE METALLOIDS.

In *Poggendorff's Annalen* (Nos. 2 and 3, 1873), Julius Thomsen, of Copenhagen, gives an account of somewhat elaborate researches on the affinity of hydrogen to the metalloids chlorine, bromine, iodine, oxygen, sulphur, nitrogen, and carbon.

The affinity of chlorine to hydrogen he determined directly; those of bromine and iodine through decomposition of aqueous solutions of bromide of potassium and iodide of potassium by means of chlorine. It was necessary here to determine the absorption-heat of hydrochloric, hydrobromic, and hydriodic acids.

The affinity of hydrogen to oxygen, in water, was determined by direct burning of oxygen in hydrogen; that of hydrogen to sulphur through the reaction of sulphuretted hydrogen with iodine. The absorption-heat of sulphuretted hydrogen he had previously ascertained.

Next, the affinity of hydrogen to nitrogen, in ammonia, was determined through decomposition of solution of ammonia by means of chlorine, the absorption-heat of ammonia being at the same time also determined.

As regards hydrogen and carbon, previous observers were pretty much at one in the case of marsh-gas and æthylene, and Herr Thomsen gave special attention to acetylene, about which no researches have been published. He determined, however, the heat of combustion of æthylene, from which the heat of combination can be deduced.

We do not here stay to describe the apparatus Herr Thomsen constructed for his experiments, but limit ourselves to a statement of the chief numerical results, and the deductions made from them.

And, first of all, the following table gives the affinities in the various cases specified:—

		c.	
HCl	=	22001	
HBr	=	8440	
HI	=	−6036	
H_2O	=	68357	
H_2S	=	4512	
H_3N	=	26707	
H_4C	=	20420	Where C
H_4C_2	=	−10880	denotes
H_2C_2	=	−55010	graphite.
H_4C'	=	23780	Where C'
$H_4C'_2$	=	−4160	denotes
$H_2C'_2$	=	−48290	charcoal.

From this it appears that the affinity of hydrogen to chlorine, bromine, and iodine, decreases in a marked way with the increasing atomic weight of these substances. In the case of chlorine it is strongly positive; less for bromine; and negative for iodine. This seems to be a general relation; for in the next natural group of the metalloids also—oxygen, sulphur, selenium, and tellurium—we have, for the first two members, 68357 c. and 4512 c.; and, from M. Hautefeuille's researches, it appears that the affinity in seleniuretted hydrogen is negative, showing a close correspondence in these three with the first three—chlorine, bromine, and iodine.

In the third natural group—nitrogen, phosphorus, arsenic, antimony, and bismuth—the affinity of hydrogen to the first, nitrogen, is positive, viz., in ammonia, 26707 c. That, in the others, the affinity decreases with the increasing atomic weight, appears from the properties of their several hydrogen combinations; they are all easily decomposed by heat, arseniuretted hydrogen more easily than phosphuretted hydrogen, and still more easily antimonietted hydrogen (decomposed even at ordinary temperature); while there is no known combination between bismuth and hydrogen, probably on account of high decomposability. Doubtless, therefore, in this group also, the same thing holds good.

In the carbon group, the affinity in the case of the first member, CH_4, is 20420 c., or strongly positive; that it is considerably less in the next, silicium, may be inferred from the behaviour of siliciuretted hydrogen; while, with the higher members, tin and platinum, no such compounds occur. Thus, in all the four groups, the law may be said to hold.

Examining a little more closely the halogen group, we do not perceive, between the first three numbers in the above column a simple relation. The difference between the first and second is 13561 c., while that between the second and third is 14476 c. (not very far apart from the other). But the three numbers are not directly comparable with each other, because chlorine, bromine, and iodine are not found in the same aggregate state. To estimate the affinity for all the three substances in the gaseous state, we should add to the last two numbers the latent heat of transformation into gas. Doing so, we have the numbers 22001 c., 120090 c., −2986 c., the differences becoming 9911 c. and 15076 c. These numbers are more irregular than the former, so that bromine does not now stand about midway between chlorine and iodine. Indeed—

$$9911 = 2 \times 4956 \text{ c.}$$
$$15076 = 3 \times 5025 \text{ c.}$$

which factors might, perhaps, be taken as identical, on account of uncertainty in determination of the latent heat of iodine, but it is difficult to say whether this relation is more than an accident.

It appears, then, from these (and other) comparisons, that bromine, with reference to the affinity for hydrogen, stands very much nearer to chlorine than its atomic weight (almost midway between those of chlorine and iodine) might lead us to expect.

Consider, next, the numbers in the above table expressing the affinity between carbon and hydrogen. If we take the first group, in which carbon is in the form of graphite, we have—

$$C_2H_2 = -55010$$
$$C_2H_4 = -10880$$
$$CH_4 = +20420$$

From this it appears that the formation of the first of these hydrocarbons is accompanied with a marked absorption of heat. We might be inclined to say that the affinity of carbon for hydrogen was *negative*; it is found, however, that hydrogen, in uniting with the already-formed lower hydrocarbons, causes a considerable development of heat. Thus—

$$C_2H_2 = -55010 \text{ c.}$$
$$C_2H_4 - C_2H_2 = C_2H_2,H_2 = +44130 \text{ c.}$$
$$2CH_4 - C_2H_4 = C_2H_4,H_4 = +51720 \text{ c.}$$

And there can be no doubt that the affinity between carbon and hydrogen is, in fact, *positive*, as appears, also, from the determination $CH_4 = +20420$ c. How is this peculiar relation of carbon to hydrogen to be explained? And what is the cause of the remarkable phenomenon, that carbon appears inactive towards hydrogen, even at a high temperature, so that, only at the highest known temperature, under the influence of the electric spark, does it unite with hydrogen, with absorption of a considerable quantity of heat; that, once united with hydrogen, however, in the form of acetylene, the affinity to hydrogen appears unsatisfied, so that further quantities of hydrogen readily unite with acetylene, and that with development of heat?

If we consider the general behaviour of carbon we shall find that that has its type in this phenomenon. Carbon combines with no element at ordinary temperature; it always needs a high temperature for such combination, where possible. Thus, oxygen and sulphur combine directly with hydrogen only at a high temperature. With the remaining metalloids no direct combinations are obtainable, even at very high temperatures (with exception of hydrogen, now considered). Once combined with these other substances, however, the carbon readily enters into other combinations. Thus, *e.g.*, carbonic oxide readily combines with oxygen into oxalic acid and carbonic acid; with chlorine, into oxychloride of carbon; with hydrate of sodium, into formic acid, &c.

In agreement with this behaviour is the fact that the formation of carbon combination, is always, with one exception, accompanied by absorption of heat. Examples are—the formation of sulphuret of carbon, of cyanogen or carburetted nitrogen, of acetylene or carburetted hydrogen. The only exception is oxygen, in the combination of which with carbon heat is developed, even when the lowest oxidation product, carbonic oxide, is formed. On further comparison of these heat phenomena, however, the behaviour towards oxygen will be found only an apparent exception. We have—

$$CO = 26800 \text{ c.}$$
$$CO,O = 66800 \text{ c.}$$

Thus, while the first atom of oxygen which combines with carbon only develops 26800 c., the heat development of the second oxygen atom, which changes the carbonic oxide into carbonic acid, is about two and a half times as great. From all that has been learned as to the oxidation of other substances, we must suppose that the first oxygen atom gives the greatest, and the following give a smaller, heat development; whereas, here the reverse occurs, and we may therefore infer that, were the affinity of carbon to hydrogen generally not so great as it is, the first oxidation product here also would appear with a seemingly negative affinity.

The entire behaviour of carbon may be explained if we consider that, whether in the form of charcoal, graphite, or diamond, it is in an inactive or passive condition, out of which it must be brought before it can enter into combination with other elements, and that an expenditure of force is required for this. The data hardly permit of determining accurately the force which is necessary; it appears, however, to be about 70000 c. for each atom of carbon.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 5, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE list of visitors having been announced, and the minutes of the previous meeting read and confirmed, Mr. W. H. Greenwood was formally admitted a Fellow of the Society. The following names were then read for the first time:—Messrs. Edward Collins, William Charles Young, George Bult Francis, John Turner, and William Edward Porter.

The first paper read was entitled "*The Dioxides of Calcium and Strontium*," by Sir J. CONROY, Bart., M.A. After alluding to the circumstance that, although the existence of the peroxides of calcium and strontium had been announced by Thenard in 1817, no account of them had been published since then, the author stated that lime and strontia, unlike baryta, do not absorb oxygen at a high temperature. When, however, an aqueous solution of sodium peroxide is added to a solution of a strontium salt, a hydrated peroxide of strontium is precipitated in crystalline scales, having the composition $SrO_2,8H_2O$. The author has also obtained hydrates containing 10 and 12 molecules of water respectively. All these hydrates lose their water at 100°, leaving strontium peroxide, SrO_2, in the form of a white powder. The hydrated calcium peroxide, $CaO_2,8H_2O$, prepared by adding excess of lime-water to a solution of sodium peroxide acidulated with

nitric acid, is similar in appearance to the corresponding strontium compound, and, like it, loses its water at 100°, leaving the anhydrous calcium peroxide as a pale buff-coloured powder.

The President said the thanks of the Society were due to the author for having so satisfactorily established the existence of these dioxides. The action of an acidulated solution of sodium peroxide appeared to offer a facile method for their preparation.

Mr. T. Wills then described a new ozone generator, which he stated was a modification of one in general use. Siemens's tube had the disadvantages of being difficult to construct and very liable to be broken; moreover, it became heated after being used for some time. This last objection also applied to Bean's apparatus of glass plates covered with tin-foil. Sir Benjamin Brodie, in his experiments, had employed an apparatus similar in principle to the Siemens tube, but the tin-foil surfaces were replaced by water; this worked very efficiently, but it was not easy to adapt to other pieces of apparatus. The new generator consists of a piece of glass tube as cylindrical as possible, with an annular coating of tin-foil on the exterior; in the interior is a carefully-turned brass box, slightly smaller than the glass tube, and tinned to protect it from the action of the ozone. Through this box a current of ice-cold water can be passed, so as to prevent the heating of the apparatus, the oxygen or air passing through the annular space between the box and the glass tube, which is fitted with caps and tubes for that purpose. The brass box and tin-foil coating are connected with the induction coil in the usual way. This apparatus yields large quantities of ozone with great ease, and, with the same battery power, appears to be more powerful than either of the other forms of apparatus; its cost, moreover, is small, and it is not liable to be broken. It can also easily be adapted to other pieces of apparatus, and the current of cold water keeps the apparatus cool, thus allowing it to be used for any length of time.

The President said he had worked with the apparatus, and could fully confirm what the speaker had said. He also drew attention to the great convenience of employing paraffin joints when working with ozone, as pointed out by Sir Benjamin Brodie, since that hydrocarbon is not attacked by it.

Mr. Bean asked whether the author had compared the new form of apparatus with his, using the same surface, as he had found that with the same battery power a small surface gave more ozone than a large one.

Mr. Tisley, in reply to a question of Mr. Bean as to the difficulty of obtaining large glass tubes, said that, for a large ozone apparatus, it would probably be better to use a number of comparatively small tubes worked in cascade.

Mr. W. N. Hartley then read a paper "*On the Behaviour of Acetamide when Heated with Sodium Alcohol.*" The author heated sodium methylate with acetamide in hopes of obtaining methylamine, but the reaction took a different course; ammonia was evolved, but no compound ammonia was produced. On repeating the experiment with sodium ethylate, no ethylamine was obtained, but ammonia was given off, and a crystalline substance resembling cholesterine formed in the solution. This, however, when examined microscopically, was found to consist merely of feathery crystals of acetamide enclosed in plates of sodium ethylate. Acetamide and sodium ethylate, even when mixed dry and heated to redness, do not yield any compound ammonia.

The President having thanked the author for the care and perseverance with which he had conducted his experiments,

Dr. Armstrong said he could confirm Mr. Hartley's results, as a few years ago he had himself endeavoured to prepare ethylamine from sodic ethylate and acetamide, and had obtained nothing but ammonia.

The Secretary then read a paper "*On Iodine Monochloride,*" by J. B. Hannay. In preparing this substance the author employed the usual processes, namely, passing chlorine into iodine until it becomes liquid and then rectifying the product, also by heating a mixture of iodine and potassic chlorate, and rectifying the product over potassic chlorate. He notices many curious circumstances connected with the crystallisation of this substance, which possesses a deep red colour in a liquid state, and when crystallised is "of a brilliant plumbago or iodine lustre." It melts at 24·7°, boils at 100·5° to 101·5°, and has a density of 3·263 at 0°. Its vapour density at 120° was found to be 80·27; theory, 81·2. Iodine chloride is decomposed by water, iodine being precipitated, and iodic acid and hydrochloric acid formed; the latter dissolves a small portion of iodine monochloride and prevents its decomposition. The compound was analysed, and its behaviour observed with numerous substances both elementary and compouud. The author did not succeed in obtaining the iodine tetrachloride described by Kämmerer, although he made numerous experiments with that object.

Dr. Odling said the Society was much indebted to the author for his careful investigation of this substance, which was the more interesting as it was the only known example of an electro-negative monochloride.

The next communication, "*On Triferrous Phosphide,*" by R. Schenck, was read by the author, who prepared this substance by pouring a solution of ferrous sulphate into a flask in which phosphoretted hydrogen was being evolved by the action of potassic hydrate on phosphorus. The precipitate of ferrous hydrate at first formed, rapidly becomes grey, and finally black. After removal of the phosphorus, the iron phosphide was purified by boiling it with a solution of potassic hydrate, and subsequently with hydrochloric acid. The results of the analyses corresponded to the formula Fe_3P_2; the phosphorus appearing to be trivalent. The ferrous phosphide dissolves slowly in boiling acids, with evolution of gas, and in the dry state takes fire below 100°, burning to a reddish-brown powder. The author intends to apply the same method to the preparation of other phosphides.

The President having thanked the author in the name of the Society, a paper "*On Sulphur Bromide,*" by J. B. Hannay, was read by the Secretary. On adding bromine to sulphur in the proportions to form SBr, heat is developed, and a deep red liquid formed, of density 2·629, which cannot, however, be distilled without decomposition. On exposure to the air it absorbs moisture, and crystals of sulphur are deposited which are soluble in carbon disulphide. It dissolves phosphorus with evolution of heat, but on attempting to distil the solution it explodes; this would seem to be owing to the sulphur bromide acting merely as a solvent for the phosphorus until heat is applied, when a decomposition suddenly takes place. With iodine chloride, sulphur bromide yields sulphur chloride and bromide of iodine. Its behaviour with methylated spirit, potassium, sodium, aluminium, and arsenic are also described.

The President, after returning thanks to the author for his communication, adjourned the meeting until Thursday, June 19, when the following papers will be read:—1. "On the Influence of Pressure upon Fermentation, part II., by Horace Brown; 2. "Researches on the Action of the Copper Zinc Couple on Organic Bodies, III.," and "On Normal and Isopropyl Iodides." by Dr. J. H. Gladstone and A. Tribe; 3. "On Cymenes from Different Sources Optically Considered," by Dr. J. H. Gladstone; 4. "On the Action of Bromine on Alizarine," by W. H. Perkin; 5. "On some Decompositions and Oxidation Products of Morphine and Codeine Derivatives," by E. L. Mayor and Dr. C. R. A. Wright; 6. "On the Decomposition of Tricalcic Phosphate by Water," by R. Warington; 7. "On a New Tellurium Mineral, with Notes on a Systematic Mineralogical Nomenclature," by J. B. Hannay; 8. "Communications from the Laboratory of the London Institution, No. XII.; On New Derivatives of Cresol," by H. E. Armstrong and C. L. Field.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 12, 1873.

Tumefaction of Obsidian when Exposed to an Elevated Temperature.—MM. Boussingault and Damor.—Obsidian exposed to the action of fire suffers no change at a cherry-red heat, but between an orange-red and a red-white it swells up suddenly to a colourless spongy mass, not unlike pumice. At higher temperatures it resumes its vitreous state. The authors, in studying this phenomenon, find that the loss of weight per gramme in no case exceeded 0·00730 grm.; that the increase of bulk was from 200 to 700 per cent; that the emission of gases was slight, and in many cases absolutely *nil*; that the loss of weight was due chiefly to the escape of water and hydrochloric acid.

New Researches on Aldol.—A. Wurtz.—The author remarks that his view on the double nature of aldol as at once an aldehyde and an alcohol have been confirmed. Aldol after distillation, even when refrigerated, re-heats spontaneously; the temperature, in a receiver surrounded with ice, having been found to rise from 11° to 54° in seventy minutes. On cooling it becomes viscid. It possesses the reducing power common to the aldehydes. The author regards it as the aldehyde of β-oxybutyric acid. The paper concludes with a protest against the criticism of Kolbe.

Isomeric and Allotropic Transformations.—Troost and Hautefeuille.—The authors bring forward a body of novel facts which establish an intimate connection between the physical phenomena of evaporation and the chemical phenomena of isomerism and allotropy. Striking analogies have been already established between the respective phenomena of condensation (of vapours) and of combination, and again between those of evaporation and of decomposition. Carbonate of lime in decomposition obeys the same laws as the evaporation of water. Since 1868 the authors have been studying the law of the phenomena of a change of state, when such change corresponds to a change of chemical or physical properties without an alteration of composition. They have assimilated these phenomena to those of dissociation, and have applied the same procedure for their measurement. They have observed a "tension of transformation." They show, as regards the decomposition of the cyanides of silver and mercury, that the proportion of paracyanogen in the residue increases with the pressure exercised by the cyanogen liberated; the transformation is limited by the tension of the gas, which depends on the temperature. This fact has led them to discover the inverse transformation of paracyanogen into cyanogen gas, which begins about 360°, and is slow even at 500°. They show also that cyamelide and cyanuric acid under the influence of heat behave like paracyanogen. Reciprocally cyanic acid in vapour is transformed into cyanuric acid, and the tensions which limit this novel phenomenon are numerically equal to those obtained in the inverse transformation. They also study the phenomena of tension, and the calorific phenomena which attend the transformation of white phosphorus into its red state. They establish a sharply-marked distinction between the tension of vapour in a limited space, and the tension of transformation of the same body. This distinction permits us to analyse thoroughly the allotropic transformation of phosphorus. They show that the conversion of ordinary phosphorus into its liquid and its red state is quite comparable to the transformation of liquid cyanic acid into cyamelide. They show that the vapour of phosphorus acquires first its maximum tension corresponding to the temperature employed. This tension gradually lessens during the formation of red phosphorus, and attains a constant value—the *tension of transformation* at the same temperature. Phosphorus boils under ordinary atmospheric pressure at 290°. At 360° and 440° the tension becomes respectively 3·2 and 7·5 atmospheres. At 577° it had risen to 56 atmospheres.

New Process for the Proximate Analysis of Rocks.—M. Fouqué.—1 to 2 kilos. are reduced to a coarse powder (¼ millimetre in diameter): the powder is divided into two portions, the one for mechanical, and the other for chemical examination. The former is submitted to a powerful electro-magnet set in action by 6 to 8 Bunsen elements. All the ferruginous parts are thus removed. The chemical treatment consists in the use of concentrated hydrofluoric acid for a short time. This process has been applied successfully in an examination of the lavas of Santorino.

Action of Sulphur on Arsenic.—A. Gélis.—The author has obtained the sulphides of arsenic by direct action. On heating sulphur with an excess of metal there is formed a single product, the bisulphide S_2As. It is red, opaque, and crystalline, and is distinct from the "false realgar" of commerce. With an excess of sulphur we obtain the pentasulphide S_5As. If 1 part arsenic is heated in a flask with 7 to 8 parts of sulphur the metal disappears, forming a transparent liquid, which when cooled takes the consistence of india-rubber; in time it becomes brittle. Ammonia separates it into pentasulphide, which dissolves, and free sulphur. On distillation we obtain first sulphur, then sulphur containing arsenic. The pentasulphide remains, but it is not stable, for at higher temperatures it is resolved into sulphur, and a trisulphide S_3As. The sulphide of carbon acting upon the arsenical sulphur presents curious phenomena. It abandons at first all the common sulphur which it contains, and the liquid becomes coloured. At each new treatment it removes a little sulphur without becoming saturated. Artificial realgar and orpiment are mixtures of the various sulphides of arsenic.

Action of Hydrochloric Acid Gas upon the Compound Ammonias.—Ch. Lauth.—Reserved for full insertion.

Action of the Oxygen Dissolved in Water upon Reducing Agents.—P. Schützenberger and Ch. Risler.—Hyposulphite of soda and ammoniacal cuprous oxide when in contact, in the cold and in excess, with oxygen dissolved in water, cause the latter to be divided into two portions; one of which oxidises the reducing agent, whilst the other remains in the liquid. Stannate of soda removes the whole of the dissolved oxygen. The authors believe that the oxygen remaining in the water enters into combination therewith. Thus, aërated water strongly coloured with carmine of indigo was exactly decolourised with hyposulphite. It resumed a blue colour on heating to 40°. The colour reappeared also in the cold, though more slowly. If we decolourise a second time the same phenomenon is reproduced until hyposulphite has been added enough to decolourise in the cold the same volume of aërated water. A dilute solution of oxygenated water produces the same effects.

Portative Force of Magnets.—M. J. Jamin.—The author exhibited two magnets made on his system; one weighing 6 kilogrms. and carrying 80; the other (thought to be the most powerful ever made) carries about 500 kilogrms., having a weight ten times less. He explains the principles on which the best possible magnet may be

constructed from plates of a given steel and length. They are briefly these:—(1) The contact should conceal the entire magnetism expanded over the exterior surface of the magnet; for this a sufficient mass should be given it. (2). This mass given the surface of adherence should be reduced till one perceives an increase in the small amount of free magnetism which the application of the contact leaves on the magnet. (3). The length and breadth of the plates being determined, their number should be sufficient to cause a little free magnetism to appear on the magnet when the contact is applied. If their number is less, the limit of permanent force is not reached; if greater, nothing more is gained. (4). The armatures should be strong and well applied; their weight should not, however, be exaggerated. M. Jamin shows how on these principles he constructed the magnets in question.

The Seine; Hydrological Studies.—M. Belgrand.

Electro-Diapason with Continuous Motion.—M. Mercadier.—The author wished to construct an apparatus capable—(1) of dividing time into very small equal fractions; (2) of doing so continuously; (3) of conveniently registering these fractions. The instrument he made is as follows:—A tuning-fork is placed upright, and a small electro-magnet is fixed on a support opposite the face of one of its branches; which, on the other side, has fixed to it an "interruptor style" of platinum wire. The other branch has also a style which registers its movement on a rotating blackened cylinder. Between the branches is a platinum plate on a separate support; and with this plate the interruptor style comes into contact when the branches approach each other. The positive rheophore of a pile is connected with the plate; the negative with the electro-magnet. If now the plate is put in contact with the interruptor style a spark appears, the current passes, the diapason begins to vibrate, and the interruptor style synchronously with it. The distance of the plate is varied till the maximum amplitude of vibration is obtained. This instrument is said to work very satisfactorily.

Observations Relative to the Notes of M. du Moncel and of MM. Thenard on the Decomposition of Carbonic Acid by the Electric Effluve.—M. J. G. Jean.

Observations Relative to a Communication of M. du Moncel on the Condensed Effluve of the Induction Discharge.—M. Houzeau.—The writer calls attention to his simple-action and double-action *ozonisers*, omitted rom M. du Moncel's description of apparatus for experiments of this kind.

Modification of the Optical Saccharimeter.—M. Prazmowski.—Soleil's instrument requires considerable perfection in the visual organ to appreciate exactly the uniformity of colourlng in the two halos of the field; and, in view of this, some have sought to improve on it by making the observation depend on perceiving a slight difference between two luminous intensities. M. Frellet and M. Cornu have suggested means of effecting this. M. Prazmowski's method is to use a bi-plate of spar (in place of Soleil's plate with two rotations), the face of separation being placed in the principal section of the rism. He utilises Soleil's compensator.

Spring Frosts and Winter Frosts.—M. Martha Beker.

May 19, 1873.

New Observations concerning the Influence of Metallic Deposits upon Zinc in presence of Acids and Bases—New Processes of Heliography.—M. C. Gourdon.—Zinc, coated with certain metals, becomes exceedingly liable to be attacked by reagents. Thus, if a sheet of this metal is coated in part with a thin layer of pulverulent platinum, it is capable of being attacked by sulphuric acid diluted with 7000 vols. of water. If the platinum is replaced by gold, the zinc can be dissolved by sulphuric acid diluted with 5000 times its volume of water. Copper causes action up to 4000 volumes, silver to 3500, tin to 1500, antimony to 700, bismuth to 500; mercury does not react similarly. If placed upon the zinc in the form of a salt it produces a spot which gradually extends itself. The solution of the zinc is most active on the margin of the spot. The soluble arsenites, arseniates, and antimoniates give spots variable in appearance. They promote the solution of the zinc, but more feebly. Cobalt, nickel, and iron resemble platinum in the intensity of action they occasion when deposited upon zinc. Cobalt renders zinc soluble in sulphuric acid diluted with 10,000 volumes of water. Salts of the same base, with different acids, do not behave identically. Chlorides yield more energetic deposits than sulphates, and these, again, than nitrates. Salts rendered alkaline by the addition of a trace of ammonia give more energetic deposits than the same salts used alone. Some salts which produce no deposit when used alone give very energetic ones when previously treated with ammonia, *e.g.*, p otosulphate of iron. The most active salts are those whose saline solutions give, with ammonia, precipitates soluble in excess. Zinc covered with metallic deposits is also easily attacked by alkalies. The author considers that the rugosity of the zinc plays a more important part in these phenomena than electricity. By utilising these reactions, the author has devised two methods of photographic engraving.

Action of Ammoniacal Gas upon Nitrate of Ammonia.—F. M. Raoult.—If a stream of dry ammoniacal gas is passed over crystalline nitrate of ammonia, the salt fuses and the gas is absorbed. This phenomenon takes place at ordinary pressure, and at all temperatures from $-15°$ to $+25°$. The liquid, on exposure to the air, loses a part of its ammonia, and deposits crystals containing 1 equivalent of the gas united to 1 of the salt. These crystals continue to lose ammonia till pure nitrate of ammonia remains. An aqueous solution of ammonia dissolves much more nitrate of ammonia than does pure water.

Preparation and Properties of Oxymaleic Acid.—E. Bourgoin.—The new acid differs from maleic acid by 2 equivalents of oxygen, and from malic acid by 2 of hydrogen.

Maleic acid	$C_8H_4O_8$
Oxymaleic acid	$C_8H_4O_{10}$
Malic acid	$C_8H_6O_{10}$

To obtain this acid, the author prepares monobromomaleate of baryta, and precipitates the baryta by sulphuric acid. The monobromomaleic acid thus obtained is saturated with a dilute solution of caustic potassa. The solution of the neutral salt is stirred up in the cold with oxide of silver well washed and recently prepared. The bromine is separated as bromide of silver, and oxymaleate of potassa remains. The filtrate is precipitated with acetate of lead, and the oxymaleate of lead, after washing, is decomposed with sulphuretted hydrogen. The acid is evaporated to dryness and re-dissolved in ether, when it appears in the form of fine elongated crystals arranged in stellar groups. It is white, solid, resembling malic acid in taste, and very soluble in water, alcohol, and ether. It is a bibasic acid.

Acid Derivatives of Naphthylamine.—D. Tommasi.—Naphthylacetamide—

$$\left.\begin{matrix} C_{10}H_7 \\ H \\ C_2H_3O \end{matrix}\right\} N.$$

This body represents acetamide in which 1 atom of hydrogen is replaced by naphthyl, $C_{10}H_7$, and is formed by the action of chloride of acetyl or glacial acetic acid upon naphthylamine. It is prepared by heating 1 part of naphthylamine with 4 parts of crystalline acetic acid to the boiling-point for five to six hours in a cohobator. The contents of the vessel are then poured into cold water, when naphthylacetamide is precipitated. It is thrown on a filter, washed, and re-crystallised from boiling alcohol. It forms white, silky needles, melting at 152°, and capable of sublimation at 160°. It is insoluble in

cold, and sparingly soluble in boiling water; very soluble in hydrochloric, acetic, and dilute sulphuric acids. It does not become coloured on exposure to the air, nor when treated with chromic acid or chloride of lime.

Naphthyl-chloracetamide—

$$\left.\begin{matrix} C_{10}H_7 \\ H \\ C_2H_2ClO \end{matrix}\right\} N.$$

This body differs from the former by the substitution of 1 atom of chloracetyl for 1 atom of acetyl, and is prepared by the reaction of chloride of acetyl upon naphthylamine. It forms silky needles, colourless, fusible, and sublimable at 161°, insoluble in water, but soluble in hot alcohol and acetic acid. It gives no colour with chromic acid and chloride of lime.

Chlorides of Propylene.—E. Reboul.—The normal chloride, $CH_2Cl-CH_2-CH_2Cl$, is the homologue of chloride of ethylene, CH_2Cl-CH_2Cl, or the so-called "Dutch liquor." It has a pleasant odour, and boils at 117°; its density is 1·201 at 15°. Alcoholic potassa, when hot, removes from it hydrochloric acid and changes it into chloride of allyl, and finally into ethyl-allytic ether. Chloro-propylol, $CH_3-CH_2CHCl_2$, is the true homologue of the chloride of chlorated ether, CH_3CHCl_2. Bromides of propylene are known, corresponding to three of the chlorides. The fourth, bromopropylol, might doubtless be formed by the action of perbromide of phosphorus upon propylic aldehyde. The author announces his intention of examining the chlorobromides of propylene.

Note on the Solar Cyclones, with a Reply from M. Respighi to MM. Vicaire and Secchi.—M. Faye.—M. Respighi, in his letter, asserts the excellence of his telespectroscope (called in question by P. Secchi). The chromosphere may appear, as P. Secchi says, more elevated where the spots are by a simple effect of perspective, the surrounding faculæ being projected on each other; but having carefully watched the progress of the spots in periods of quiet especially, he (M. Respighi) had often observed depression at the spot, the red layer being almost interrupted. He also urges that the rarity of reversal of spectral lines in the nuclei is a proof of the small thickness of the chromosphere there; if it were as thick and as largely mixed with luminous jets as neighbouring parts one should be constantly seeing a reversal of the lines. The reversal when observed is doubtless due to the projection of an intense jet or protuberances on the spot. M. Faye remarks on the complexity of the spot phenomena; including faculæ, jets emanating from them, depression at spot axis, the spot itself, and the solar rotation causing it, all in mutual dependence.

Note on the Mechanical Properties of Different Bronzes.—M. Tresca.—The writer arrives at the conclusion that there are bronzes more homogeneous, ductile, resistant, and elastic than those produced in the State foundries; and he calls on the Artillery Department to examine the products of private works so as to determine the bronze most serviceable for cannon.

Electro-Diapason with Continuous Movement.—Second note by M. Mercadier.—(The first appears in the previous page.)—Numerical results are cited as showing that the vibrations are synchronous, notwithstanding the intermittent action of the electro-magnet. The amplitude of the vibrations depends on the form of diapason, on the distance of the electro-magnetic poles from it, on the height at which the magnet stands, on the intensity of the current, and on the nature and length of the style.

Experiment in Electro-Dynamics.—MM. Planté and Niaudot-Breguet.—If a secondary couple (of lead plates) be charged with a Gramme magneto-electric machine, and then be left undischarged in connexion with the machine which has been stopped, the latter presently begins to turn under influence of the current from the secondary couple in the same direction as it was turned in charging; and continues turning (more slowly, indeed, yet at a considerable rate) for two or three minutes till the couple is discharged. In this restitution there is, probably, only slight loss. That the machine in its motion should turn in the same direction as before seems paradoxical, but may be explained by the laws of currents. Further, the secondary couple once charged gives a current more powerful than that produced by the machine which it puts in motion, the difference of intensities continuing the motion.

Remarks on some Peculiarities Observed in Researches on Spectrum Analysis.—L. Lecoq de Boisbaudran.—In passing the induction spark between two metallic pieces the spectral lines are chiefly or exclusively obtained at the negative pole; but with aluminium the contrary occurs. Certain solutions examined with the spark only give the air spectrum, even when negative; by moistening the exterior platinum wire this may be avoided. The presence of metallic molecules in the interpolar space enfeebles the air spectrum. The exterior wire may be brought nearer the solution when the latter is positive than when it is negative, in the latter case the liquid tends to meet the wire. The projection of the liquid in droplets; its *pulverisation* increases so rapidly with the length of spark, and varies with the liquid. The dilution of liquors influences the relative intensities of the lines. When, after long calcination in a gas-flame, there is hardly a trace of matter on the platinum wire; it is not always the lines originally brightest which persist longest. With the spark many metals do not give lines when in the compact state, but furnish beautiful spectra when finely divided. It would sometimes be of advantage to mix the metals with pure lead, from which the spark should be brought.

Classification of Absorption Bands of Chlorophyll.—M. Chautard.—The author divides the chlorophyll bands into three distinct categories. The first contains simply the band in the middle of the red; this he calls the *specific band*. In the second he includes all bands which have been observed in chlorophyll solutions, new or old, neutral, acid, or alkaline; these he calls *supernumerary bands*. The most remarkable is that which results from division of the specific band in the red, under the influence of alkalies. The third category comprises *accidental bands*, not having the permanent character of the preceding, and being produced in special conditions. Of this kind is that from a division of the specific band through acids. The additional band here seems to arise from the less refrangible side, while in the alkaline solution it arises from the other. The author gives several particulars as to the method of treating chlorophyll in order to obtain various bands.

Experimental Researches on the Influence of Changes in Barometric Pressure on the Phenomena of Life.—P. Bert.—Reserved for translation.

On Different Electric Movements Observed in Connection with the Interrupted Lightning Conductor of Greenwich Observatory.—M. de Fonvielle.—The writer pivoted a needle (by its centre) excentrically on a copper disc connected with the aërial rod of the conductor, and observed oscillatory movements in it, which he compares with what has been noticed by other observers.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, January and February, 1873.

Note on the Furnace of Danks.—Victor Tahon.—The author sums up the results of his examination of this furnace as follows:—The apparatus of Danks is a practical conception, capable of regular and prolonged employment. It suppresses the manual labour of puddling, and replaces it by a mechanical movement which is more advantageous for the purification of the iron.

The result is a reduction of the hands employed and of the expense of labour. The production is strikingly improved alike in quantity and quality.

Note on the Definition of Steel.—A. Greiner.—A mechanical paper.

On Cast Steel obtained by the Bessemer and Siemens Processes.—M. A. Noblet.—The author gives the following analytical results, obtained by Dr. Kezler:—

	I.	II.	III.	IV.	V.	VI.
Graphite ..	2·410	0·75	0·020	0·020	0·010	0·020
Carbon	0·620	2·42	3·170	1·590	0·180	0·190
Silicon	2·410	1·26	0·270	0·030	0·010	0·160
Phosphorus ..	0·130	0·14	0·135	0·130	0·140	0·150
Sulphur	0·024	0·01	0·007	0·013	0·023	0·021
Manganese ..	2·450	0·70	0·190	0·120	0·060	0·220

In this table I. gives the composition of the crude mixture before commencement; II. to V. the composition of samples taken at various stages of the process; VI. that of the finished metal. Another investigation gave—

	I.	II.	III.	IV.	V.	VI.
Graphite ..	2·52	0·140	0·040	0·010	0·000	0·000
Carbon	1·06	3·650	3·530	2·470	0·290	0·450
Silicon	1·87	1·200	0·640	0·067	0·021	0·083
Phosphorus ..	0·10	0·106	0·096	0·097	0·109	0·104
Sulphur	0·37	0·069	0·061	0·077	0·113	0·080
Manganese ..	1·04	0·230	0·080	0·060	0·050	0·340

I. represents the material; II. sample taken after four minutes; III. the beginning of the second period; IV. the middle of the second period; V. sample before the introduction of the spiegel; and VI. the finished metal. These analyses show the utter inability of the Bessemer process to eliminate phosphorus. The author concludes that the employment of ordinary pig-irons for the manufacture of steel is a problem yet unsolved.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 4, May 22, 1873.

Distillation of Petroleum-Schists.—Seguin has invented a method of effecting the distillation of these schists, in which the residues of former operations are used as fuel. The combustion takes place in a furnace of peculiar construction, placed below the retorts. In the Autun district alone this process will effect a saving of coal to the value of 1000 francs daily. The oils obtained are of fine quality, and the yield appears to be augmented.

Preservative against Rust.—Common mercurial ointment is found to be remarkably efficacious in preventing the formation of rust upon articles of iron and steel, such as gun-barrels.

Preservation of Alimentary Substances.—Dr. Sacc.—After a series of experiments, carried on uninterruptedly since 1845, the author has come to the following conclusions:—(1). That organic bodies decompose spontaneously, each in a different manner, either with or without access of air, and either with or without the intervention of microscopic animal or vegetable beings. (2). There is only one certain method of preserving organic substances,—that is by removing their vital moisture, totally or in part, by means of a salt which by remaining in their tissues may hinder the entrance of atmospheric air, and prevent the attacks of insects. (3). The salt which best attains this end, as regards speed, quality of produce, and salubrity, is acetate of soda.

No. 5, May 29, 1873.

On Hofmann's Direct Vision Spectroscope.

On Jules Dubosq's Penumbral Saccharimeter.—These two papers would not be intelligible without the accompanying diagrams.

No. 6, June 5, 1873.

This number contains no original chemical matter.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of bleaching-liquor. Henry Deacon, alkali manufacturer, Widnes, Lancashire. November 7, 1872.—No. 3309. Bleaching-liquor is usually formed by causing a mixture of caustic lime, and water to absorb chlorine, and the reaction may be represented by the following formula:—

$$2CaO+Cl_4+xH_2O=\left\{\begin{matrix}CaCl_2\\ CaCl_2O_2\end{matrix}\right.+xH_2O;$$

but if the caustic lime be replaced by carbonate of lime, then the reaction may be represented as follows:—

$$CaCO_3+Cl_4+xH_2O=CO_2+H_2Cl_2O_2+CaCl_2+(x-1)H_2O,$$

and the result may be described as a mixed solution of chloride of calcium and hypochlorous acid, with liberation of carbonic acid. This solution may be used for bleaching purposes instead of the ordinary bleaching-liquor, or it may be used for the production of pure chlorine by the addition to it of hydrochloric acid, or it may be converted into ordinary bleaching-liquor by the addition of caustic lime, as shown in the following formula:—

$$CaO+H_2Cl_2O_2+CaCl_2+(x-1)H_2O=\left\{\begin{matrix}CaCl\\ CaCl_2O_2\end{matrix}\right.+xH_2O.$$

Now my invention consists in using certain kinds of carbonate of lime to replace wholly or in part the caustic lime usually employed. One of the kinds of carbonate of lime I employ is that procured in a state of fine division by causticising solutions of the carbonates of soda or of potash. This finely divided material is usually a mixture of caustic lime with carbonate of lime, and may be used with water instead of caustic lime, and be impregnated with chlorine in the usual bleaching-liquor making apparatus, too well known to need description. The other kind of carbonate of lime I employ is chalk or limestone in lumps. I fill towers, or columns, or other vessels constructed of stone or other suitable materials, with such lumps of chalk or limestone, which are continually moistened with water, or with weak liquor produced in the course [illegible]the manufacture, and I pass chlorine gas or ga[illegible]s containing [illegible]lorine through the apparatus amongst the lumps of chalk or limestone. Carbonic acid gas is evolved and escapes, and a solution is obtained which may be described as containing free hypochlorous acid and chloride of calcium, which can be used as a bleaching-liquor, or it may be used for the production of pure chlorine by the addition to it of hydrochloric acid, or be converted into ordinary bleaching-liquor, by the addition of lime as before described. This improvement is especially applicable to the manufacture of bleaching-liquor by the aid of chlorine gas when mixed with carbonic acid gas, or otherwise diluted.

Improvements in the manufacture of salts and oxides of lead and in apparatus therefor. William Marriott, manufacturing chemist, Huddersfield. November 8, 1872.—No. 3322. My improved apparatus for reducing the lead to powder is constructed somewhat on the principle of the "Gifford" injector. My apparatus for converting the lead powder into carbonate of lead has a cylinder with an agitator fixed on a vertical central hollow shaft connected with a pipe whereby steam air and carbonic acid are admitted to the said shaft and to the agitator. The cylinder is supplied with water, and as the lead rises to the surface of the water it passes away through suitable exit pipes in the form of carbonate of lead.

Improvements in the manufacture of stearic acid. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Edouard Deiss, of Marseilles, France). November 8, 1872.—No. 3323. The invention consists in the application of sulphuret of carbon or other solvent producing similar results for increasing the fluidity of the oleic acid contained in fatty acids so as to facilitate its separation from stearic acid in a cold state without the use of hot pressure as heretofore. The invention is also applicable for extracting the margarine from the residues of all kinds of animal and vegetable oils, and also for the preparation of oleine from tallow for lubricating purposes.

An improved process of tanning hides and skins. Charles de Sainte Marie, doctor, Port Ste. Marie, France. November 9, 1872.—No. 3335. This invention consists—First. In the employment of solutions of the salts of ammonia, such as the chloride, acetate, azotate, and oxalate, but especially the sulphate, for the purpose of neutralising the alkalies used for removing the hair. Secondly. The employment of combined solutions of sulphate of soda and sulphate of ammonia for cleansing, preparing, and de-alkalising mucous, papillary, or other membranes.

Improved apparatus to be used in the treatment of sewage deposits and other like substances. Major-General Henry Young Daracott Scott, C.B., Ealing, Middlesex. November 11, 1872.—No. 3355. This apparatus consists of a drying floor of a corrugated or indented form, but with the elevations on the upper side so sloped as not to allow of permanent lodgments of matter upon them. In the hollows on the upper side archimedean screws are kept in rotation, and by so doing they constantly thrust forward the material to be dried.

Improvements in the treatment of human fœcal matters, and in the apparatus or means employed therein. James Alexander Manning, Inner Temple, London. November 11, 1872.—No. 3356. This invention consists:—First. Of a mode of assisting heating the tank employed for evaporating fœcal matters described in the Specification of the Patent No. 2269, A.D. 1869, by utilising for that purpose the mixture of carburetted hydrogen gas and air evolved during the process of evaporation. Secondly. In introducing steam into the evaporating

chamber through the shaft of the agitator, which is made hollow and is perforated on its under side for that purpose. Thirdly. Of an improved arrangement of water-closet, whereby the fœcal matters are discharged into a separate vessel in lieu of into the sewer, the water employed for flushing the closet being alone discharged into the sewer.

NOTES AND QUERIES.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 71.—A series of 44 experiments mentioned on this page "seem to indicate that it is the lightness of the balls that causes the discrepancies noticed on the recent occasions."

"I made 36 experiments in this manner" [with ivory balls]; "and found that the discordances were still more considerable than any which I had ever yet experienced with other balls, not only in the positions of the resting point, but also in the time of vibration. In fact, the experiments made on January 17, are so anomalous, that I have been obliged to divide them into *three* portions."

P. 72.—"The experiments made on January 20th exhibit similar irregularities. . . . . The six remaining experiments on this day present so many anomalies that the results are not entitled to much credit. For, the arc of vibration, in experiments 1539 and 1543, *increased* instead of being diminished; which evidently showed that some unlooked for disturbing force was in active operation, which affected with great irregularity both the time of vibration and the march of the resting point."

P. 72.—" . . . . . there is sufficient discrepancy to show that these light balls" [ivory] "are not the best adapted for giving uniform results, whether suspended by silk or iron."

"The experiments on January 28 assimilate to those made on January 20, inasmuch as there is great irregularity in the time of vibration and in the march of the resting point; and likewise in the circumstance that the arc of vibration, in experiment 1598, *increased* instead of being diminished, and that the last of the single results is very discordant."

P. 73.—"Not being able by these proceedings to throw any light on the cause of the discrepancies so frequently met with in these cases, I conceived it might be occasioned by a slight *twisting* of the suspension lines: for on a close examination of the lines which were now in operation, I observed that they were not exactly in the same vertical plane, there being nearly 30° difference between the upper and lower positions."

P. 74.—"As I was desirous of ascertaining the true cause of the discordances that still existed at every slight change of the apparatus, I resolved on pursuing some further experiments with different balls, where no other alteration whatever (except the change of the balls) should be made in the arrangement or disposition of the apparatus . . . . . ."

P. 75.—" . . . These 60 experiments . . . afford satisfactory evidence that, when the same mode of suspension is adopted, the slight differences that arise are principally caused by the difference in the weight of the balls successively attached to the torsion-rod. Other causes of difference, however, may be suspected to arise from a variation in the mode of suspension."

P. 77.—"It must be confessed that the results, with these light balls, have not in general been so accordant as those obtained with the heavier ones."

P. 78.—" . . . . those anomalies which, however trifling in their effect upon the general result, evidently showed that some disturbing force was in operation that had hitherto escaped detection. The discordances most difficult of solution were those that occurred when the light balls were employed; more especially when the ivory balls were used."

MEETINGS FOR THE WEEK.

TUESDAY, 17th.—Anthropological, 8.
—— Zoological, 8.30.
WEDNESDAY, 18th.—Meteorological, 7. Anniversary.
THURSDAY, 19th.—Royal, 8.30.
—— Philosophical Club, 6.
—— Chemical, 8. Horace Brown, "On the Influence of Pressure upon Fermentation; Part II." Dr. J. H. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies (III.), and on Normal and Isopropyl Iodides." Dr. J. H. Gladstone, "On Cymenes from Different Sources Optically Considered." W. H. Perkin, "On the Action of Bromine on Alizarine." E. L. Mayor and C. R. A. Wright, "On Some Decomposition and Oxidation Products of Morphine and Codeine Derivatives." R. Warington, "On the Decomposition of Tricalcic Phosphate by Water." J. B. Hannay, "On a New Tellurium Mineral, with Notes on a Systematic Mineralogical Nomenclature." Dr. H. E. Armstrong and C. L. Field, "Communications from the Laboratory of the London Institution; No. XII. On New Derivatives of Cresol."

THE CHEMICAL NEWS.

VOL. XXVII. No. 708.

ON PHENOLCYANINE.

By T. L. PHIPSON, Ph.D., F.C.S., &c.

THIS new substance is derived from phenol, and appears to me to possess considerable interest, from the analogies it presents with certain colouring matters derived from lichens, and inasmuch as it may perhaps throw some light on the constitution of indigo. It is obtained directly from phenol by dissolving the latter in alcohol, adding liquid ammonia, and allowing the mixture to remain for some weeks in a partially-closed flask; but, in about fifteen days, when the liquid has become a rather dark green, twice its volume of water and one quarter of its volume of ammonia are added, and the mixture is left to itself for about six weeks. By this time the liquid has taken a very fine blue tint, very dark, and a certain quantity of phenolcyanine is found at the bottom of the vessel and adhering strongly to the glass. That which remains in solution can be collected by saturating the liquid with salt. The product is thrown on a filter, and the new substance dissolved in hot alcohol or benzol, from which it is obtained by evaporation.

Properties.—Thus obtained, phenolcyanine is a resinous substance of a very dark blue, nearly black, and showing metallic copper-coloured reflections like indigo. In alcohol, it forms a fine deep blue solution, in ether a reddish purple-blue, and in benzol a reddish purple solution. Concentrated sulphuric acid dissolves it easily, forming a bluish green liquid; hydrochloric acid has little action; and nitric acid forms a nitrous compound very different from picric acid. Phenolcyanine is very slightly soluble in water, but dissolves in hydrated alcohol to which ammonia is added, and this solution can be considerably diluted with water. These alkaline solutions are deep sky-blue by day, but of a vinous red by night or when a flame is seen through them. Acids redden these solutions, and alkalies bring back the blue, as with litmus. Nascent hydrogen reduces phenolcyanine, and renders it completely colourless, but when the solution remains exposed to the air in presence of ammonia the blue colour soon returns. A mixture of ferrous sulphate and lime does not destroy the colour of phenolcyanine as it does that of indigo-blue; so that the former rather resembles the coloured derivatives of orcine than it does indigo. Phenolcyanine melts very easily, and can be partially volatilised in purple vapour; the remainder is decomposed, and leaves a porous charcoal.

Composition.—My analyses of this new product have not been very satisfactory, on account of the very small quantity which I have yet had at my disposal for this purpose; I believe, however, that I can assign to it the formula $C_{12}H_5NO_2$, or $C_{12}H_7NO_4 = C_{12}H_5NO_2 + 2HO$. According to the most recent analyses, orceine is $C_{14}H_7NO_6$, and indigo-blue $C_{16}H_5NO_2$, so that it is possible both may some day be formed from phenolcyanine. I hope to be able soon to refer to its composition again.

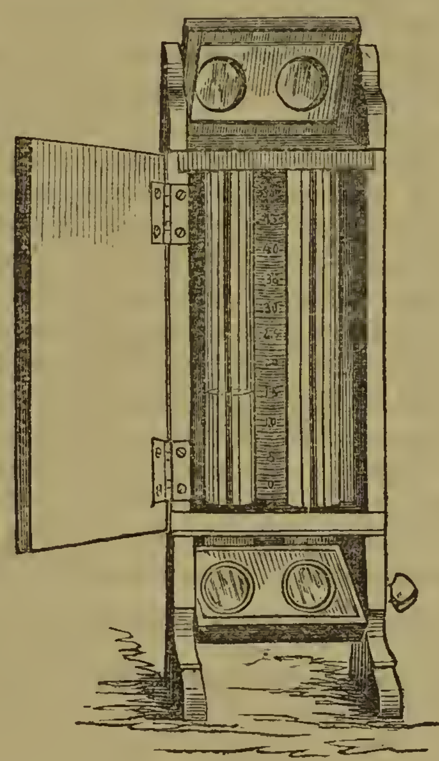
COLORIMETRIC ANALYSIS.

By GEORGE E. DAVIS.

IN the CHEMICAL NEWS, vol. xxvii., p. 262, Mr. Sidney Harvey has devised a colorimeter very similar to one devised by myself, which I have had in constant use for over three years; in fact, Mr. Harvey's instrument is almost an exact counterpart of my original colorimeter, which I was obliged to modify completely before I could depend upon its indications.

The above is an engraving from a photograph of the colorimeter as it is now in use. I may describe it thus:—It consists of a mahogany box, 6 ins. by 3 ins., and $1\frac{1}{4}$ ins. deep, into which can be inserted two white glass tubes with flat bottoms. The tubes themselves are $6\frac{1}{2}$ ins. long, and $\frac{7}{8}$ in. in diameter; the holes upon which they rest are $\frac{7}{8}$ in. in diameter; and half of the foot-board is cut away to $\frac{7}{8}$ in., in order to admit and to steady the tubes. The tubes are placed $1\frac{1}{2}$ ins. from centre to centre, and between the tubes is a scale, preferably graduated into millimetres. The tops of the tubes are held in position by the top of the case, being made so that half takes away; then the tubes are easily abstracted for emptying, cleaning, &c. Now above the tubes is a mirror swinging upon a pivot on each side, which serves to throw the light *down* the tube, and *below* is a similar mirror for *observation.*

If the tubes are now partly filled with standard ammonia which has been Nesslerised, and if the light be thrown up the tubes, we shall see a great deal of the white glass in the top mirror, which prevents to a great extent the exact colour being obtained; and the greater the difference in



level of the liquid in the tubes, the greater the amount of interference in the tint.

Nor is this all to be guarded against, for the tubes ought to be made of the same glass to give accurate results. This fact manifested itself to me in December, 1870, when one of the tubes was broken, and before using the colorimeter, whatever tubes are employed, it should be tested by filling the tubes to an equal height with a coloured liquid, when, of course, the discs upon the mirror should be identical. My instrument is always used in a vertical position, the top mirror throwing the light through the tubes down upon the bottom mirror; the bottom of my tubes are *flat*, and the size of the mirrors 3 ins. by $2\frac{1}{4}$ ins.

My method of procedure is nearly similar or it may be styled identical with Mr. Sidney Harvey's. It is thus—I take 100 c.c. of the solution in which the ammonia is to be determined, add Nessler, shake, and allow to stand for a quarter of an hour. With this solution I fill one of the tubes half-full, and notice the tint on the mirror below. I then make a solution to correspond as nearly as possible (with my standard ammonia) to the solution in the other tube, and enter it in the note-book as containing n milligrammes of ammonia in a litre. This solution, 100 c.c. of which have been Nesslerised, is then added in the empty tube by a fine pipette until the discs appear the same below. Now, supposing the unknown solution stood at a height of 37 m.m. in one tube, and the standard solution in order to obtain the same tint was added until 49 m.m. was reached; then, if this standard solution, contained

0·7 milligramme in a litre, the quantity of ammonia in the unknown solution would be—

$$\frac{0{\cdot}7 \times 49}{37} = 0{\cdot}92.$$

I first arranged this apparatus in June, 1870, and did a deal of work with it in water analysis until February, 1871. In March, 1871, it was used in a series of experiments upon the estimation of carbon in cast-iron, and since then it has been used by several chemists in different researches where quantitative determination by depth of colour could be performed.

Walsall, June 11, 1873.

INFLUENCE OF OPTICALLY-INACTIVE SOLVENTS ON THE ROTATORY POWER OF OPTICALLY-ACTIVE SUBSTANCES.

This subject is discussed by Dr. A. C. Oudemans in a recent number of *Poggendorff's Annalen*.

Reviewing the work of previous observers, he states that Biot, having found (simultaneously with Seebeck), in the year 1815, that circular polarisation was obtainable from a liquid of organic origin, viz., oil of turpentine, was led to a series of researches, from which it appeared that many other liquids, both purely organic compounds, and solutions of solid organic substances in some inactive liquid, gave the phenomenon in varying measures. For use of comparison, in studying the laws of circular polarisation, Biot adopted the expression *specific or molecular rotatory power*, meaning thereby (for a determinate ray of light) the turning of the plane of polarisation, caused by a layer of the active substance 1 decimetre thick, having a degree of concentration = 1, and a density = 1. Hence, if α denote the directly-observed turning of the plane, for a layer l decimetres thick, of a simple solid or liquid combination whose density is δ, the specific rotatory power (a) of this substance will be $= \frac{\alpha}{l.\delta}$.

For solutions of active substances in inactive liquids, the formula takes the form—

$$(\alpha) = \frac{a}{\epsilon.l.\delta},$$

where ϵ denotes the degree of concentration, *i.e.*, the relation between the weight of the active constituent and that of the entire liquid.

Biot inferred, from his earlier experiments, that the specific rotatory power (say, S.R.P.) of a dissolved active substance was independent of the degree of concentration; but he afterwards perceived that what he had considered a common case was the exception, and not the rule. With tartaric acid, especially, was the influence of concentration conspicuous.

It was further established, by Biot and others, that temperature had some influence on the S.R.P. of active substances in solution.

The influence of the *nature of the solvent* has been only slightly investigated. In chemical handbooks it appears to be often taken for granted that the S.R.P. is not affected by the solvent, where the latter has no so-called chemical action on the active substance. Biot and Jodin have published a few observations on the point; the former having examined the different effects, on rotatory power of tartaric acid, of water, alcohol, and wood-spirit used as solvents; while the latter found the rotatory power of inverted sugar affected differently by water and by alcohol.

Unacquainted with the influence of inactive solvents now referred to, Dr. Oudemans was accidentally led to study the subject when examining the rotatory power of sulphate of cinchonine. Merely to facilitate solution of the salt in water, which was taking place very slowly, he added some alcohol, not expecting this would affect the rotatory power. Several experiments thus made, with different quantities of alcohol, gave such different results, optically, as could only be attributed to the alcohol added.

In prosecuting the inquiry to which he was thus attracted, he used one of Wild's polaristrobometers and the lime-light. The solutions were brought to a temperature of 17° or 18°. [Sundry other details are given as to the mode of preparing the solutions, &c.] The following table shows the principal results:—

Substance examined.	Solvent.	Degree of Concentration.	Specific Rotatory Power. Degrees.
Cane sugar ..	Water.	0·056	R 66·9
,,	Alcohol 50 p.c.	0·050	R 66·4
Light cubebin oil	Unmixed.	—	L 40·8
,,	Alcohol.	0·061	L 41·6
,,	Benzol.	0·060	L 41·6
,,	Chloroform.	0·075	L 41·7
Cinchonine ..	Alcohol.	0·006 – 0·008	R 228·0
,,	Chloroform.	0·004 – 0·005	R 212·0
Sulphate of cinchonine	Water.	0·014	R 169·0
,,	Alcohol.	0·023	R 191·0
,,	,,	0·055	R 193·0
Nitrate of cinchonine	Water.	0·020	R 154·0
,,	Alcohol.	0·022	R 172·0
Hydrochlorate of cinchonine ..	Water.	0·016	R 162·0
,,	,,	0·026	R 158·0
,,	,,	0·031	R 156·0
,,	Alcohol 93 p.c.	0·054	R 175·0
Brucin	Alcohol.	0·054	L 35·0
,,	Chloroform.	0·019	L 127·0
,,	,,	0·049	L 119·0
Podocarpic acid	Alcohol.	0·040	R 136·0
,,	Alcohol 93 p.c.	0·090	R 136·0
,,	Ether.	0·040	R 130·0
,,	,,	0·070	R 130·0
Podocarpate of soda	Water.	0·046	R 82·0
,,	,,	0·064	R 79·0
,,	,,	0·138	R 73·0
,,	Alcohol.	0·090	R 86·0
Phlorizin	,,	0·046	L 52·0
,,	Wood-spirit.	0·039	L 52·0

This affords sufficient evidence that, while sometimes (as in the case of phlorizin) the S.R.P. of an active substance is not perceptibly modified by the solvent; still, as a rule, the use of different solvents, in circumstances otherwise similar, produces greater or smaller differences. With cane sugar, only a slight difference is observed. The differences are very great in the case of alkaloids and their compounds. The rotatory power of brucin is, in the chloroform solution, nearly one and a half times as great as in the alcohol solution. It is possible that all alkaloids behave generally like cinchonine and brucin in this respect.

In the course of his experiments, Dr. Oudemans observed the curious fact that the S.R.P. of cinchonine in solution with mixtures of alcohol and chloroform is modified in quite a different way from what might naturally be expected from the influence of the two liquids separately. Thus, in the above table, the value of (α) for cinchonine dissolved in alcohol = R 228°; and for cinchonine dissolved in chloroform = R 212°. One might anticipate that, with mixtures of both solvents, the values of (α) would lie between these numbers, and would be greater the more alcohol there was in the mixture, and *vice versa*. It is not so, however, as the following table shows:—

No.	Composition of Solvent.	Value of (α). Degrees.
1.	100·00 p.c. $CHCl_3$ + 0·00 p.c. C_2H_6O	R 212·0
2.	99·66 ,, ,, + 0·34 ,, ,,	216·3
3.	98·74 ,, ,, + 1·26 ,, ,,	226·4
4.	94·48 ,, ,, + 5·52 ,, ,,	236·6
5.	86·95 ,, ,, + 13·05 ,, ,,	237·0
6.	82·26 ,, ,, + 17·74 ,, ,,	234·7
7.	65·00 ,, ,, + 35·00 ,, ,,	229·5
8.	44·29 ,, ,, + 55·71 ,, ,,	226·6
9.	27·54 ,, ,, + 72·46 ,, ,,	227·6
10.	17·02 ,, ,, + 82·98 ,, ,,	227·8
11.	0·00 ,, ,, + 100·00 ,, ,,	228·0

It appears, from the numbers thus obtained (and which Dr. Oudemans represents in a curve),—

(1). That, in alcoholic solution of cinchonine, about the half of the alcohol may be exchanged for chloroform without the S.R.P. of the cinchonine being notably affected. On the other hand, if, in a solution of cinchonine in chloroform, only 1-300th of the solvent be exchanged for alcohol, the S.R.P. is already altered 4°.

(2). The S.R.P. of cinchonine is about a maximum when the solvent mixture contains 10 per cent alcohol and 90 per cent chloroform.

(3). From the influence which two liquids have separately on the S.R.P. of an active substance, no inference can be drawn as to the effect of a mixture of them.

On the last account it is important, in examining the S.R.P. of active substances, to ascertain the purity of the solvent used.

Dr. Oudemans next sought to determine whether the influence of different solvents on the S.R.P. of an active substance was connected with the greater or less solvent power of liquids for the active substance. If this were the case, the S.R.P. of an active substance should probably be more modified by an inactive liquid in which it is easily dissolved, than by one in which it is dissolved with difficulty.

To test this, he determined the solubility of cinchonine in alcohol, in chloroform, and in mixtures of these liquids. The results are as follows:—

No.	Composition of Solvent.	Percentage Quantity of Dissolved Substance. (Weight of solvent=100.)
1.	100·0 p.c. alcohol + 0·0 p.c. chloroform.	0·77
2.	90·9 ,, ,, + 9·1 ,, ,,	0·94
3.	77·6 ,, ,, + 22·4 ,, ,,	1·27
4.	64·9 ,, ,, + 35·1 ,, ,,	1·83
5.	47·7 ,, ,, + 52·3 ,, ,,	3·30
6.	34·9 ,, ,, + 65·1 ,, ,,	4·84
7.	27·4 ,, ,, + 72·6 ,, ,,	5·67
8.	22·8 ,, ,, + 77·2 ,, ,,	5·88
9.	18·2 ,, ,, + 81·8 ,, ,,	5·81
10.	7·8 ,, ,, + 92·2 ,, ,,	4·14
11.	1·9 ,, ,, + 98·1 ,, ,,	1·34
12.	0·0 ,, ,, + 100·0 ,, ,,	0·28

With these data he constructs a curve of solubility, and it appears—

(1). That the solubility of cinchonine in chloroform is smaller than in alcohol.

(2). That, starting from the two zero points, the solubility of cinchonine, with increasing quantities of chloroform, rises much less than with increasing quantities of alcohol.

(3). That cinchonine is most soluble in a mixture of 20 per cent alcohol and 80 per cent chloroform.

Comparing the curve here obtained with the former curve, they appear to resemble each other, in that both the S.R.P. and the solubility of cinchonine rapidly rise with the increase of the alcohol contents, and also that a smaller solubility of alcohol in chloroform corresponds to a smaller S.R.P. They differ, inasmuch as the maximum of solubility does not coincide with the maximum of S.R.P., and the substitution of chloroform for alcohol immediately modifies the solubility, but not the S.R.P.

Still Dr. Oudemans considers that the solubility and the S.R.P. of active substances stand in a certain connection. For the present, one is not in a position to explain satisfactorily the differences in the two curves; he suggests, however, that possibly, in mixture of the two liquids, other actions take place which affect the S.R.P. Thus it may be that something of the same kind takes place as was observed by Dupré and Page in mixtures of alcohol and water, with reference to specific heat; viz., that some mixtures have a greater specific heat than the individual constituents. In such a case, perhaps the S.R.P. might be affected by the thermic condition of the solvent, as well as by the influence of solubility.

In agreement with the supposition that greater values of (α) for the same active substance always correspond to a greater solubility in the solvent used, are the numbers given in the first table in this paper.

A. B. M.

ON THE EFFECTS PRODUCED BY ELECTRIC CURRENTS ON MERCURY IMMERSED IN DIFFERENT SOLUTIONS.*

By M. Th. Du MONCEL.

IN a former communication the author had considered the secondary current which appears at the same time as the current of polarisation to be caused by some action resulting from the combination of the two gases liberated at the electrodes. He now finds the action is more complex, consisting chiefly in amalgamation of metals in the saline solution with the mercury, under electric influence.

When mercury forms the negative electrode in an electrolyte, the force of the secondary currents depends on the oxidability of the metal added (to the mercury), the concentration of the solution, the facility of union between the metal and the mercury, and the stability of the saline combination. The continuance of the current's action is proportional to the time of electrolysation, and various circumstances affecting the union of metal with mercury. A small proportion of a salt capable of furnishing an energetic secondary current, introduced into a saline solution not thus capable, gives it the power of producing intense currents. Thus, a solution of pure sulphate of bioxide of mercury, with a negative mercury electrode, gives hardly any current; but a few particles of bicarbonate of soda or sulphate of zinc added will furnish a very strong current.

When the mercury forms the positive electrode, the energetic secondary currents produced arise most often from oxidation of the mercury, and the reduction of salts which result from it, by hydrogen condensed on the negative electrode. These currents are much more durable than those formed at the negative electrode. The most important obtained were from solutions of sulphate of soda, sulphate of zinc, sulphate of iron, and chlorhydrate of ammonia. M. Du Moncel gives a table of the results from some twenty different solutions.

PROCEEDINGS OF SOCIETIES.

ROYAL DUBLIN SOCIETY.

A COURSE of four lectures are being delivered at present by Dr. J. Emerson Reynolds upon Spectrum Analysis. These lectures are free to the public, and at the conclusion of the course a spectroscope is to be given away as a prize

* Abstract.

for the best answering. The fourth or concluding lecture takes place on Friday next, when a description of the practical applications of the spectroscope will be given. No expense has been spared as regards the illustrative experiments connected with the course, and we need hardly say that they have proved eminently successful in the hands of Dr. Reynolds.

ROYAL GEOLOGICAL AND ZOOLOGICAL SOCIETIES OF IRELAND.

There was a joint meeting of the above societies on Wednesday, June 11, Prof. Hull, Director of the Geological Survey of Ireland, in the chair.

Prof. Macalister exhibited a specimen of the *Hippopotamus Liberiensis*, and contrasted its anatomy with the extinct species.

Prof. C. R. Tichborne then read a paper on the "*Formation of Minerals having the Spherical or Radical Form.*" The object of this paper was to prove that many minerals, such as wavellite, were actually separated in the colloid form as a fluid non-homogeneous with the menstruum from which they are deposited.

A discussion followed, in which Profs. Sullivan, Reynolds, and Hull took part.

Mr. Hardman's paper, "*On the Occurrence of Zinc in the White Chalk of the County of Tyrone*," was read in the absence of the author.

CORRESPONDENCE.

ACETAMIDE AND ETHYLATE OF SODIUM.

To the Editor of the Chemical News.

Sir,—I observe, in your report of the meeting of the Chemical Society on June 5, an account of a paper by Mr. Hartley on the above subject.

According to Mr. Hartley, acetamide, when heated with methylate of sodium, gives *no* methylamine, and, when heated with ethylate of sodium, it gives *no* ethylamine. In both instances, however, Mr. Hartley observed the evolution of ammonia; but, on making a microscopic examination of the solid product in the latter instance, he found it to consist "merely of feathery crystals of acetamide enclosed in plates of sodium ethylate." Whereupon, as appears from your report, the President thanked the author for the care and perseverance with which he had conducted his experiments.

Possibly it did not strike the President that there was any absurdity in finding that a mixture of acetamide and ethylate of sodium loses ammonia, and, having done so, consists "merely of feathery crystals of acetamide enclosed in plates of sodium ethylate."

The other objection to the results of Mr. Hartley's microscopic examination, viz., that the crystalline plates of ethylate of sodium are in reality not ethylate of sodium, but a compound of alcohol with ethylate of sodium, which suffers decomposition at the temperature at which acetamide is likely to act upon ethylate of sodium, requires some degree of knowledge of the substances in question in order to be appreciated; but, at any rate, after it has been pointed out to him, the cogency of the former of these objections can hardly fail to be palpable to the President of the Chemical Society.

That neither methylamine nor ethylamine was formed in the experiments is an interesting negative result, and will doubtless perplex chemists who regard methylate and ethylate of sodium as consisting of the alcohol radical bound to the metal by means of oxygen. The experiment of Beilstein published some twelve years ago, and showing that ethylate of sodium and acetic ether yield no trace of common ether, and my own more recent investigations, which showed that these substances yield acetate of ethylene-sodium and alcohol, indicate that there is an equivalent of easily-replaceable hydrogen in ethylate of sodium, and negative the view that ethylate of sodium consists of ethyl and sodium bound together by oxygen.

To me the non-production of methylamine and ethylamine in the above instance appears as a natural result of the theory which I have put forward. According to me, acetamide will either refuse to attack ethylate of sodium, or else it will yield ammonia and acetate of ethylene-sodium. If Mr. Hartley *perseveres* in his investigation, and works in an intelligent manner, he will, I hope, find out which of these alternatives is the true one.—I am, &c.,

J. Alfred Wanklyn.

London, June 16, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 26, 1873.

Estimation of the Luminous Phenomena Produced in the Interior of Transparent Media Animated by Rapid Translation where the Observer Himself Participates in the Translation.—M. Boussinesq.—The following law is enunciated by the author. The luminous phenomena perceived by an observer involved in a common movement of translation with reference to the ether, with the source of light and with interposed media, do not differ from those he would observe on contemplating the same source through the same transparent media if—there being no translation—the density of the ether became, in each respective medium, and for waves of a determinate direction, greater than it is in the proportion of unity to the square of the sum of unity and the quotient of the component of the translation velocity in the direction of the normal to the waves, by the velocity of propagation of the latter in the medium considered.

Electric Balance, and an Electro-Static Phenomenon.—M. Volpicelli.—The law of electro-static action revealed by Coulomb's balance depends on a considerable number of causes or forces as follows:—(1) Repulsion or attraction between the electric charges; (2) curvilinear induction between the two spheres; (3) rectilinear induction between them; (4) the attraction of the substances surrounding the spheres; (5) electrisation of the insulating rods; (6) non-uniformity in the distribution of electricity on the spheres; (7) want of reciprocal rectilinear action of the parts of the charge distributed on the surfaces not facing each other; (8) increase of the initial charges through induction of one sphere on the other; (9) the circumstance that one may not refer entirely to the centre of one of the two spheres the electric charge which acts on the other; (10) the loss during experiment of part of the induced electricity of the first kind, and the diminution thus produced; (11) the imperfect elasticity of the suspension thread, its variability with temperature, and its hygrometric state (if not metallic). Thus it appears that the two investigations of the law, one mathematical, the other experimental, are hardly comparable. M. Volpicelli adds some remarks on an experiment described thus in

Les Mondes :—" Let the knob of a gold-leaf electroscope be touched with a bar of vulcanised caoutchouc electrified negatively by rubbing with cat-fur; then remove the rod. Next bring near to the knob a body electrified negatively; the divergence of the leaves diminishes. This phenomenon would be inexplicable if the electroscope were charged negatively; experiment shows, then, that after removal of the rod there remains an excess of positive fluid." He asks, whence this positive excess, and traces it to the fact that electrified non-conductors (unless moistened) do not communicate their electricity to metals they touch, but act merely by induction.

Researches on the Electricity Produced in Mechanical Actions.—M. Joulin.—Induced by observation of the electrical phenomena produced in belts for the transmission of motion, M. Joulin constructed new electric machines in order to study such phenomena, consisting each of a belt and two pulleys. For the pulleys he used cast-iron, copper, zinc, wood, leather, hardened caoutchouc, wool, and silk. For the belt, leather differently prepared, having a pulverulent coating of talc, resin, or oxides: or a coating of wool, silk, or gutta-percha. The maximum velocity of the belt was 1200 metres; the maximum tension weight 300 kilogrms. The motor pulley rested on fixed, the other on sliding, supports. M. Joulin observed the points at which a metallic sphere (with fine needle attached) brought near the system first became luminous in the dark; and these points, taken together, gave surfaces of equal potential. He states the results for conducting and for non-conducting pulleys; and indicates how the permanent electric state is established in the machine. He finds that the free electricity perceived is the dynamical charge accompanying a current which is propagated through the belt; a charge which, according to Ohm's law, decreases from one extremity to the other of the belt, as the ordinates of a trapezium for conducting pulleys and those of two similar triangles for non-conducting pulleys.

Conditions of Maximum of Magnetic Effect in Galvanometers and Electro-Magnets.—Note by M. Raynaud.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 246, June, 1873.

Notes on the Recent Progress of Chemical and Metallurgical Manufactures of England.—G. Lemoine.—The author reviews the improvements of Weldon and Deacon in the manufacture of bleaching-lime; the use of revolving furnaces in the alkali trade; the utilisation of vat-waste; the preparation of sulphate of soda by the process of Hargreaves; the method of Schlœsing and Rolland for obtaining carbonate of soda by the action of chloride of sodium and bicarbonate of ammonia; the process of Gibbs for utilising burnt pyrites; the manufacture of magnesia and of carbolic acid. (We cannot help pointing out that the results of such a tour of inspection would have been more instructive if undertaken by a chemist instead of an "engineer of bridges and highways." M. Lemoine should remember the proverb, "Chacun à son métier.")

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, May 12, 1873.

Sulphur Derivatives of Cymol.—A. P. Fleisch.—In the preparation of cymol by distilling camphor with the sulphide of phosphorus there are formed, in addition to cymol and other hydrocarbons of the benzol series, a body resembling phenol, soluble in alkalies, and capable of re-precipitation by acids. This substance was found to be a sulpho compound, $C_{10}H_{14}S$, or $C_{10}H_3SH$; a colourless liquid insoluble in water, and miscible with alcohol in all proportions. It boils at 235° to 236°, and has at 17·5° the sp. gr. 0·9975. It may be named thiocymol, or thiosulphydrate. Oxidising agents convert it into cymol-bisulphite $(C_{10}H_{13})_2S_2$. By treating either this compound or the cymol-sulphydrate with nitric acid we obtain sulphotoluylic acid—

$$C_6H_3\begin{cases}CH_3\\CO_2H\\CO_3H\end{cases}$$

By fusing this sulphotoluylic acid with hydrate of potassa two oxyacids are formed. The more soluble oxytoluylic acid consists of—

$$C_6H_3\begin{cases}CH_3\\CO_2H\\OH\end{cases}$$

and is distinguished from the three acids of the same percentage composition by giving no violet colouration with the perchloride of iron. The less soluble of the two acids, when purified by repeated precipitation, gives results on analysis which agree more closely with the formula of dioxybenzoic acid, $C_7H_6O_4$, than with that of oxyterephthalic acid, $C_8H_6O_5$. The formation of the latter is, however, the more probable.

Solubility of Saline Mixtures.—F. Ruedorff.—The author remarks that on this subject little is known beyond the fact that salts are generally more or less soluble in the solutions of other salts than in pure water. He proposes to arrange for this purpose saline mixtures in two classes. I. Mixtures where no chemical change can take place, *i.e.*, salts with identical acids or identical bases. II. Mixtures where chemical changes are possible, *i.e.*, salts with two bases and two acids. The experiments with salts of the same base, or the same acid, showed that with some saline mixtures saturated solutions may be obtained by simply using an excess of both. In other cases the composition of the resultant solution depends on the relative proportion of the two salts submitted to the action of water. A respectively larger amount of either salt modifies the composition of the solution, so that the salts have a power of mutually excluding each other. As a matter of course, in such cases it is impossible to state the composition of the saturated solutions. Of two isomorphous salts the less soluble is expelled from solution by the more soluble.

Action of Ozone upon Pyrogallol.—J. D. Boeke.—The dark colour produced by ozone in an alcoholic solution of pyrogallol gradually disappears on prolonged action, and passes ultimately into an orange or a yellow. Beside carbonic acid and volatile fatty acids there is formed a new crystalline acid, which appears to contain 37·07 per cent of carbon, and 4·88 per cent of hydrogen, corresponding with the formula $C_6H_6O_7$.

Removal of Nitrogen from the Alkaloids.—J. D. Boeke.—The author, with reference to a preliminary communication from Prof. Hlasiwetz on the same subject, finds that when a mixture of quinine with powdered zinc sodium and excess of zinc-powder is heated in a combustion-tube to dull redness, a liquid is obtained with a pleasant smell of carraway, and free from nitrogen. The residue in the tube contained cyanide of sodium. On further experiments cinchonin was found to behave in a similar manner. Quinine may be obtained in fine crystalline needles from solution in chloroform.

Chemical Nature of Desoxybenzoins and Kindred Substances.—Br. Radziszewski.—The author considers desoxybenzoin as a keton. By submitting to destructive distillation a mixture of benzoate and phenylacetate of lime he obtained, amongst other products, benzol-benzyl-keton, $C_{14}H_{12}O$, agreeing both in composition and properties with desoxybenzoin. Benzoin he considers to be at once a keton and a pseudo alcohol.

Action of Bromine upon Boiling Æthyl-Benzol.—Br. Radziszewski.—The product, whether washed with water and dried, or unwashed, was entirely decomposed on distillation. Bromide of hydrogen was liberated in

abundance; the thermometer remained for a time constant at from 145° to 150°, and then rose gradually to 190°. In the retort remained a black mass containing ordinary crystalline bibromstyrol. The distillate behaved in the same manner on re-distillation. Phenylbromethyl, almost pure, can be obtained by acting upon ethylbenzol at the temperature of 140° with a slight excess of bromine. On heating 2 equivalents of bromine with 1 of ethylbenzol to 145° to 150° we obtain a crystalline compound, $C_8H_8Br_2$, identical with bibromstyrol, which, when passed over quick-lime at dull redness, gives two compounds—(1) A liquid hydrocarbon, C_8H_6, boiling at 140°, and identical with Glaser's acetenylbenzol; and (2) a crystalline substance fusing at 119°, and which when dissolved in benzol gives a fine red colour with picric acid. An alcoholic solution of picric acid gives neither a red precipitate nor colouration, which proves the absence of pyeren.

Nitro-Anthracen and its Derivatives.—Ernst Schmidt.—The author seeks to identify as a new product the hydrocarbon which he has obtained, isomeric with anthracen. The similarity of the melting-point (247°) to that of para-anthracen (244°) might lead to the view that both were identical. This is not the case. Not merely the behaviour of the two bodies with reagents, but the phenomena displayed on fusion are quite distinct. Para-anthracen returns on fusion to common anthracen, its melting-point falling from 244° to 213°; whilst the author's hydrocarbon can be fused repeatedly, and even heated to 300°, without undergoing any change of fusibility. The new hydrocarbon on treatment with boiling nitric acid is converted into a yellow nitro product, $C_{14}H_9(NO_2)$, without formation of a trace of chinon. On the other hand, para-anthracen is not nitrised by boiling with concentrated nitric acid; and common anthracen is almost entirely converted into anthrachinon and dinitro-anthrachinon. The behaviour of the new hydrocarbon with bromine differs from that of anthracen. On oxidation with chromic acid, the reaction being carefully moderated by refrigeration, a chinon is produced, $C_{14}H_8O_2$, which sublimes and crystallises in splendid red needles, fusing at 235°, and consequently totally distinct from the pale yellow ordinary anthrachinon, fusible at 273°. The new chinon dissolves in concentrated sulphuric acid with an intense and splendid indigo-blue colour. On the addition of water the colour disappears, and the chinon separates out unchanged. The mononitro product of anthracen, described by Phipson as resulting from the direct action of nitric acid upon anthracen, is not identical with the author's mononitro-anthracen, and its derivative amido-anthracen.

Propyl-Phenyl-Keton.—Ernst Schmidt and E. Fieberg.—Of the compound ketons of the aromatic series which along with phenol contain a radical of the fatty acid series, hitherto only the methyl-phenyl and ethyl-phenyl-ketons, have been examined. The authors have added a new homologue to the series by the preparation of propyl-phenyl-keton—

$$\left.\begin{matrix}C_6H_5\\C_3H_7\end{matrix}\right\}CO$$

It is obtained by the destructive distillation of a mixture of benzoate and butyrate of lime and fractional distillation of the crude product. When purified it is a pale yellow liquid, of a pleasant aromatic odour and burning taste. It boils at 220° to 222°, and its sp. gr. at 15° = 0·99. In this keton series there appears a certain regularity in the boiling-points, similar to that observed in the normal ketons of the fatty series. Thus, methyl-phenyl-keton boils at 199°; ethyl-phenyl-keton at 210°; propyl-phenyl-keton at 220° to 222°. On the average the addition of CH_2 raises the boiling-point 11°.

On a Hydrocarbon in Vegetable Fats.—J. Kœnig and J. Kiesow.—The former of these authors has previously stated his opinion that a hydrocarbon containing a higher percentage of carbon must occur along with wax. This supposition they consider verified. They have obtained from hay a fatty matter, which when freed from traces of cholesterine contained—

Carbon	84·96
Hydrogen	15·28
	100·24

fusing at 65° to 66°, and congealing at 65·8° to 65°.

Action of Chlorethyl upon Anhydrous Sulphuric Acid.—Th. v. Purgold.—The main product of the reaction is chlorosulphuric ether, $C_2H_5ClSO_2Cl$. When purified it distils almost entirely between 80° and 96°. The washings were found to contain isaethionic and chlorisaethionic acids. With ammonia chlorosulphuric ether reacts very violently, the mass becoming carbonised except rise of temperature is carefully prevented. With phenol the ether forms a clear liquid, which, if heated in the water-bath to 60°, gives off chlorethyl and hydrochloric acid. The products of the reaction are a thick, turbid, aromatic oil (neutral phenyl-sulphuric ether?), and two sulphacids not yet examined.

Phthaleine of Hydrochinon and Chinizarine.—F. Grimm.—The brownish-red, thick, fused mass, obtained on heating togerher hydrochinon and anhydrous phthalic acid, becomes gradually solid and crystalline when exhausted with boiling water. On treatment with absolute alcohol, and dilution of the extract with water, the colouring matter is first deposited. On heating the filtrate, and adding more water, the phthaleine crystallises out, and can be purified by repeated solution in a little ether, and final crystallisation from alcohol. When pure it is a white body, fusible at 232° to 234° and congealing on cooling to a yellowish vitreous mass. From hot alcohol it crystallises in white felted needles containing 1 equivalent of alcohol. If the solution is much diluted with water the crystals take the form of nacreous scales containing no alcohol, but 1 equivalent of water, which they lose at 160° to 180°. To obtain chinizarine the fused mass of phthalic acid, hydrochinon and sulphuric acid, after having been boiled in water is extracted with absolute alcohol and precipitated with water; or else treated with benzol which dissolves chinizarine readily, but phthaleine sparingly. When purified by re-crystallisation from alcohol and ether it is composed of $C_{14}H_8O_4$. It crystallises from ether in orange scales; from benzol and alcohol in dark red needles. The solutions in ether and in sulphuric acid display a greenish-yellow fluorescence resembling that of Stenhouse's munjistin, prepared from munjeet. This body possibly stands in the same relation to chinizarine as does purpurine to alizarine. When heated chinizarine sublimes in coloured needles and plumose crystals resembling alizarine, leaving a shining charcoal behind. The melting-point of the sublimed body is 194° to 195°; that of the crystals from alcohol 192° to 193°. With alkalies it yields blue solutions with a slightly violet tinge, which is most decided in case ammonia is employed. With baryta it gives a fine blue-violet compound; with alumina a red lake playing into violet; and with magnesia a deep blue-violet body. Chloride of iron gives a brown-red, and acetate of lead a dull red precipitate in the feebly alkaline solution. If the alcoholic solution is allowed to stand for some time it becomes colourless; whilst a deep violet or black precipitate is deposited, which re-dissolves in alkalies with a blue colour. At a boiling heat the alkaline solution is decolourised by zinc-powder, but on exposure to air quickly resumes its colour. Chinizarine is not only isomeric with alizarine, but the two bodies stand in the closest connection. If the vapours of chinizarine are passed over heated zinc-powder we obtain white shining scales which, after sublimation, melt at 210° to 212°, and give a red compound with picric acid. It is highly probable that chinizarine is converted into anthracen

when heated with zinc-powder. The author considers that his results support the view of Fittig that anthrachinon is a double keton of benzol. The following observations on the absorption spectra of chinizarine and alizarine, due to Prof. Kundt, may be of interest. It should be noted that the alizarine had merely been purified by sublimation, and might, therefore, contain purpurine :—

Alizarine.	Chinizarine.
D at 172° of the scale; C at 157·5°.	E, 191°; F, 208·5°; G, 243°.
1. Solution in Soda Lye.	
Three dark bands; their centres. (1). 166. (2). 177. (3). 190 (very faint).	Only 2 direct bands visible, their centres. (1). 169. (2). 121.
2. Solution in Carbonate of Potassa.	
(1). Dark band above mentioned at 166. (2) and (3) forming a broad washed-out band in which the two maxima of darkness were not easily distinguished.	In a concentrated solution only one band, absorbing the whole blue portion from 167°. In dilute solutions 2 faint dark bands. (1). 171. (2). 184.
Solution in Ether.	
If concentrated no bands visible; the whole blue part absorbed from 190°. If less concentrated a faint dark band at 193° Another band beginning at 205°; behind this a maximum of light, followed again by absorption.	Three bands visible. (1). 195° } Distinct. (2). 201° } (3). 209. Fainter and twice as broad as the former.
Solution in Sulphuric Acid.	
In concentrated solutions a very peculiar faint band at 163°. Appearance of a band at 181°. Dilute solutions; a very faint band at 203°.	In concentrated solutions three bands; in dilute only two. (1). At 183°. (2). At 197°. (3). Very faint at 212°.

Mono-Bromacrylic Acid Obtained from β-Bibromopropionic Acid.—R. Wagner and B. Tollens.—The authors obtained the acid $C_3H_3BrO_2$ by treating β-bibromopropionic acid with potassa. It is capable of combining with hydrobromic acid to form a crystalline acid fusible at 63° to 64°, and identical with the bibromo-propionic acid.

α-Bibromo-Propionic Acid Obtained from Propionic Acid.—G. Phillippi and B. Tollens.—The two bibromo-propionic acids differ in crystalline form. A solution of each is induced to crystallise by the addition of a solid particle of its own kind; whilst a portion of the other not only fails to set up crystallisation, but is itself dissolved. The two acids are still more clearly distinguished by their behaviour with nascent hydrogen; the β modification yielding acrylic acid, whilst the α form produces propionic. The respective salts of the two acids are also distinct.

Nature of the Elements.—J. A. Groshans.—(Two papers.) Reserved for complete insertion.

Thermo-Chemical Determination of the Affinity of Oxygen for Sulphur, Selenium, and Tellurium.—Julius Thomsen.—The author concludes that the mutual affinity of oxygen and selenium in both stages of oxidation is smaller than that of oxygen and sulphur, and also than that of oxygen and tellurium, which latter element holds a middle place in the scale. This result may seem unexpected, as it is commonly supposed that the relations of affinity in a group of elements increase or decrease with the atomic weight. Such a proportion occurs in the case of hydrogen compounds when the affinities decrease as the atomic weights increase, as—

$$Cl > Br > I.$$

In oxygen compounds this law does not hold good, the affinities of the same group for oxygen being—

$$Cl > Br < I.$$

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The same holds good with the group just examined, the affinities for oxygen being—

$$S > Se < Te.$$

In both these elementary groups the two first members have the greatest resemblance, in a chemical point of view, and differ more widely from the third.

Notes from the Greifswald Laboratory.—H. Limpricht.—(1). The picrate and dibromide of phenanthren have been formed and examined by Hayduk. The former, $C_{14}H_{10}C_6H_3(NO_2)_3OH$, forms fine yellow acicular crystals, fusible at 143° The dibromide, $C_{14}H_{10}Br_2$, forms four-sided prisms which fuse at 98°, and undergo spontaneous decomposition even in closed vessels. Bromphenanthren, $C_{14}H_9Br$, one of the products of the decomposition of the above salt by heat forms slender white prisms, fusible at 63°. The chinon of phenanthren, $C_{14}H_8O_2$, constitutes orange needles, fusing at 202°. (2). Paulz, in submitting chlorinated sulphide of toluol, $(C_6H_4Cl,CH_2)_2S$, to distillation obtained a compound, $C_{14}H_8S_2$, in white brilliant scales, fusible at 208°, and capable of sublimation without decomposition. (3). Pechmann has succeeded in obtaining the chloride of benzylsulphonic acid, $C_6H_5CH_2SO_2Cl$.

On Isokreatine.—H. Salkowski.—This compound is an isomer of kreatine, obtained by the addition of alanine and cyanamide. It is distinguished from kreatine by taking up no water of re-crystallisation. The aqueous solution, if free from alanine, remains colourless when boiled with oxide of copper.

Ketons Formed from Aromatic Acids and Hydrocarbons.—M. Kollarits and V. Merz.—Reserved for full insertion.

Bulletin de la Societe Chimique de Paris, tome xix., No. 11, June 5, 1873.

Preparation and Properties of Oxymaleic Acid.—Ed. Bourgoin.—We have elsewhere given the substance of this paper.

Claim of Priority raised by J. Thomsen respecting the Principles of Thermo-Chemistry.—M. Berthelot.—A controversial paper.

Action of Hydrochloric Gas upon the Compound Ammonias.—Ch. Lauth.—It is known that "Paris violet" is prepared on the large scale by the action of oxidising agents upon methyl- and dimethyl-aniline, and that these bases are obtained by heating the hydrochlorate of aniline with methylic alcohol under pressure. In the "Neues Handwörterbuch der Chemie," p. 632, Hofmann states that methyl-aniline, thus prepared, contains always methyl-toluidine, and concludes that the formation of the violet is analogous to that of magenta, with the difference that in the former case we operate upon methylated bases. This view does not agree with the following facts:—Methyl-aniline yields, on oxidation, larger quantities of violet the higher is its degree of purity. It seems that, if it were proper to operate upon a mixture of methyl-aniline and methyl-toluidine, it would be simpler to set out with a mixture of aniline and toluidine, instead of a pure aniline. Again, the methyl-aniline, obtained by the action of iodide of methyl upon aniline, yields violet, though the reaction takes place at a very low temperature, whilst the introduction of methyl into the residue C_6H_5 only takes place, according to Hofmann, at an elevated temperature. The presence of methyl-toluidine cannot be

shown in methyl-aniline, either by fractional distillation or bythe fractional crystallisation of salts. A current of dry hydrochloric acid gas was passed into methyl-aniline kept in a state of gentle ebullition, the apparatus being disposed so as to absorb the excess of gas on its exit from the receiver, and to collect the gases formed during the reaction. The presence of the chloride of methyl could not be mistaken. On operating upon 50 grms. of methyl-aniline, more than 30 litres of gas are collected in two or three hours; the disengagement then slackens, but does not entirely cease for two days. When the liberation of chloride of methyl is at an end, the apparatus is cooled. The product becomes a hard crystalline mass, which is dissolved in boiling water and crystallised. The crystals, on treatment with caustic soda, yield pure aniline. This aniline, reproduced from methyl-aniline, does not contain toluidine. In a similar manner, methyl-toluidine, heated in a current of hydrochloric gas, yields chloride of methyl and toluidine, without a trace of aniline. These facts prove that the methyl-aniline employed in the manufacture of Paris violet contains neither toluidine nor methyl-toluidine, and that, contrary to the view of Hofmann, the production of this colour does not require the simultaneous action of methyl-aniline and of methyl-toluidine. The action of hydrochloric acid upon these bases appears to be of general applicability, as it will permit us to recognise the presence of alcoholic groups of the fatty series, simple or substituted, and thus determining the nature of some isomeric bodies.

Method of Analysing Glycerines.—P. Champion and H. Pellet.—Commercial glycerines, according to the manner of their preparation, contain certain foreign bodies, such as glyceric ethers, volatile fatty acids, &c. Samples agreeing in specific gravity and in whiteness may differ in their degree of purity. The following process will be found useful for ascertaining their quality:—An acid mixture is prepared beforehand, consisting of 1 part of fuming nitric acid and 2 parts of pure sulphuric acid at 66° Baumé. The nitric acid should be previously deprived of its hyponitric fumes, by heating it in the water-bath to 80°, and passing through it a rapid current of air until all the colour has disappeared. 250 grms. of the refrigerated mixture are then weighed out, and placed in a suitable flask surrounded with cold water. On the other hand, 30 grms. of the sample of glycerine are weighed out. The glycerine is poured, drop by drop, into the nitrosulphuric mixture, constantly stirring with a thermometer, and taking care that the mixture does not exceed the temperature of 25°. The exact quantity of glycerine employed is then determined by a second weighing of the beaker. After standing for half an hour, the nitroglycerine collects at the upper part of the acid mixture, and the whole is poured into a large earthen vessel containing from 1 to 2 litres of cold water, avoiding too great a development of heat. The nitroglycerine is precipitated in states which vary with the purity of the glycerine operated upon. If a crude, impure sample, has been employed, the product is opaque, and collects with difficulty. In certain cases, it takes the form of clots, which do not unite on shaking. This comes from the interposition of a quantity of water, which forms an emulsion with the nitroglycerine. In order to dry the product, it is saturated with a weak solution of caustic soda. It is washed, and, when the excess of water has been removed, it is mixed with an equal volume of wood-spirit. It is evaporated in the water-bath, and weighed. The water is carried off along with the wood-spirit, and a clear product is obtained, more or less coloured according to the purity of the glycerine. Two successive weighings are necessary to ascertain the total expulsion of the wood-spirit and the water. The preliminary washing of the nitroglycerine is best performed in a tall glass jar, by passing a constant current of water down to the bottom by means of a glass tube. The washing may require from one to two hours. Lime, if present, should be directly determined in a portion of 30 grms. Chemically pure glycerine, concentrated *in vacuo* at 120° to 150°, yields 190 per cent of nitroglycerine. The operator is liable to violent headaches from the odour of the nitroglycerine, which may be treated with ammonia and acetate of morphia.

Determination of Nitroglycerine in Different Species of Dynamite.—P. Champion and H. Pellet.—Dynamites may be divided into two classes, according to the nature of the absorbent:—(1). Those with an inert base, such as silica, Boghead ashes, Tripoli, &c. (2). Those which, like dualine and lithofracteur, contain resin, finely-powdered coal, nitrate of potash or soda, or other bodies which are decomposed on explosion. In examining the former kind, 25 grms. of dynamite are weighed out and exhausted with pure hot methylic alcohol. The solution is then evaporated in the water-bath till the weight becomes constant. Dynamites with an active base are treated with boiling water, which dissolves out nitrates and separates resins, which rise to the surface. The nitroglycerine is then separated from the insoluble residue by means of wood-spirit, as above.

Contributions to the History of Glucinum.—A. Atterberg.—An account of the composition of some of the salts of this metal.

Polytechnisches Journal von Dr. E. M. Dingler, first number for May, 1873.

Account of a Visit to the Nitroglycerine Works of G. M. Mowbray, situated near North Adams, Massachusetts, U.S.—A. Ott.—This lengthy paper contains a detailed account of the method of preparing, on the large scale, nitroglycerine, which is here made with great care, and is, after having been purified, frozen either in bulk or in cartridges. The substance thus made differs in some particulars from Nobel's nitroglycerine; the former freezes at 7·2°, and contracts thereby 1-12th in bulk; the latter freezes at 12·8°, and expands thereby considerably. The American product cannot explode as long as it remains frozen, and is quite as colourless as water. The nitric acid employed in the preparation is manufactured on the premises, and carefully freed from any hyponitric acid, which, according to Mowbray, is an important point in the process. The glycerine is also taken quite pure, and the nitration is conducted very slowly, and aided by keeping the vessels very cold, and, moreover, by minutely dividing the liquid by means of blowing air through it. The crude nitroglycerine is carefully purified, and afterwards frozen.

Estimation of the Oxygen present in the Gases Escaping from the Leaden Sulphuric Acid Chambers.—F. Bode.—This paper contains a series of calculations exhibiting a method of arriving at an approximate result, sufficiently accurate for all practical purposes, as regards the quantity of oxygen present in the gaseous mixture alluded to.

New Industrial Process of Stearine Manufacture.—Professor Bock.—The author points out that the so-called acid saponification is misunderstood, that in reality no saponification takes place at first, and that the preliminary action of the sulphuric acid, when the operation is properly conducted, is to dissolve and disintegrate the albuminous and cellular tissues present in the raw fat, and next to dissociate the neutral fats, whereby the fatty acids may be obtained in a state of great purity.

Testing of Sulphate of Alumina (Patent Alum) for Sulphuric Acid.—J. Reimann.—The pulverised salt is put into alcohol, wherein it is insoluble, while any free sulphuric acid it might contain is soluble therein, and may be estimated by titration after filtration of the alcohol. Pure sulphate of alumina yields, with a logwood decoction, a deep violet colour, but, if free sulphuric acid is present, the colour becomes brown.

Composition of a Pottery Glaze.—Dr. H. Seger.—In 100 parts, the glaze was found to consist of—Silica, 40·56;

alumina, 6·07; oxide of lead, 40·04; peroxide of iron, 2·59; protoxide of manganese, 7·14; lime, 2·58; alkalies, 1·02. This glaze may industrially be obtained by mixing the following ingredients:—Quartz, 28 parts; litharge, 40; pipe-clay, 18; peroxide of manganese, 9; chalk, 5. The substances, finely ground, should be ignited, and next again ground to an impalpable powder, previous to being applied to the potteryware (hard earthenware).

Journal fur Praktische Chemie, No. 1, 1873.

Chemical Constitution of some of the Uranium Metals.—Dr. C. Winkler.—This exhaustive essay treats at length on the composition and chemical constitution of some minerals recently found in Saxony, viz.:—Uranospherite, consisting, in 100 parts, of—Oxide of uranium, 43·79; oxide of bismuth, 38·39; water, 4·84; oxide of cobalt, 4·22; oxide of iron, 2·75; carbonate of lime, 1·15; arsenious acid, 1·82; quartz (silica), 1·05. Formula—

$$Bi_2O_3,2U_2O_3+3H_2O, \text{ or } [U=120]\left\{\begin{matrix}(UO)_4\\ Bi_2\end{matrix}\right\}O_5+3H_2O.$$

Walpurgin, in 100 parts—Oxide of bismuth, 61·43; oxide of uranium, 20·29; arsenious acid, 11·88; water, 4·32. Typical formula—

$$[U=120]\left\{\begin{matrix}(AsO)_2\\ Bi_5(UO)_3\end{matrix}\right\}O_{12}+5H_2O.$$

Trögerit, in 100 parts—Oxide of uranium, 59·73; arsenious acid, 17·39; water, 17·03; oxide of bismuth, 0·74; oxide of copper, 0·56; oxide of cobalt, a trace; gangue, 1·69. Typical formula—

$$\left.\begin{matrix}(AsO)\\ (UO)_3\end{matrix}\right\}O_3+6H_2O.$$

Zeunerit, in 100 parts—Oxide of copper, 7·49; oxide of uranium, 55·86; arsenious acid, 20·94; water, 15·68. Formula—

$$\left.\begin{matrix}(AsO)_2\\ Cu(UO)_4\end{matrix}\right\}O_6+8H_2O.$$

Uranospinit, in 100 parts—Lime, 5·47; oxide of uranium, 59·18; arsenious acid, 19·37; water, 16·0. Formula—

$$\left.\begin{matrix}(PO)_2\\ Ca(UO)_4\end{matrix}\right\}O_6+8H_2O.$$

Contribution to our Knowledge on Indium.—C. Roessler.—The author prepared an ammonium-indium alum which, on being analysed, was found to contain, in 100 parts—Oxide of indium, 25·47; ammonium, 4·82; sulphuric acid, 26·66; water, 40·04. Formula—

$$In_2O_3(NH_4)_2O,4SO_3,18H_2O.$$

This alum is very soluble in water, but insoluble in alcohol; the acid solution becomes turbid by boiling.

Analysis of the Chalybeate Water of Homburg.—Dr. R. Fresenius.—The source yields 2160 litres of water in twenty-four hours. Sp. gr. of the water at 20°, 1·007080; temperature of the water (that of the air being, at the moment of observation, 11°), 18·75°. 1000 parts of this water contain (the carbonates taken as neutral salts)—Chloride of sodium, 5·863199; chloride of potassium, 0·248320; chlorlithium, 0·012067; chlorammonium, 0·013187; chlorcalcium, 0·497721; chlormagnesium, 0·315457; iodmagnesium, 0·000015; brommagnesium, 0·000676; nitrate of potassa, 0·001874; sulphate of lime, 0·003725; sulphate of strontia, 0·010616; sulphate of baryta, 0·000420; carbonate of lime, 0·722479; carbonate of magnesia, 0·061417; carbonate of protoxide of iron, 0·071385; carbonate of protoxide of manganese, 0·004054; carbonates of the protoxides of cobalt and nickel, 0·000024; basic phosphate of lime, 0·001017; silica, 0·017190; total of fixed constituents, 7·844843; carbonic acid combined with the carbonates, 0·378699; free carbonic acid, 2·042990; sulphuretted hydrogen, 0·000671. The following substances are present in this water in unweighable quantity:—Oxide of cæsium, oxide of rubidium, alumina, oxide of copper, oxide of antimony, arsenic acid, boracic acid, fluorine, organic matter, nitrogen, and marsh gas. 1000 c.c. of water contain 1082·93 c.c. of free, and 200·74 c.c. of combined, carbonic acid, and 0·4583 c.c. of sulphuretted hydrogen.

What is to be considered Good Potable Water?—E. Reichardt.—An hygienico-chemical essay.

Metamorphosis of Bones.—Dr. C. Aeby.—A pathologico-chemical memoir.

No. 2, 1873.

Estimation of Nitric Acid Present in Potable Waters by Means of Indigo.—F. Fischer.—This paper contains, in the first place, a *resumé* of the researches of Marx, Goppelsroeder, Bemmelen, and others, on this subject; and further, the results—chiefly exhibited in tabulated forms—of the author's experiments made with the view to ascertain the correctness of this process: it would appear that, with due care and frequent repetition of the estimation of nitric acid in the same sample of water, reliable results may be obtained.

Artificial Formation of Fluoride of Calcium and of Heavy Spar.—Th. Scheerer and E. Drechsel.

A Very Simple and Rapidly-Acting Method of Filtration, based upon Bunsen's Process.—Dr. E. Fleischer.—This paper is illustrated with woodcuts.

On some of the Derivatives of the Cyan-Carbonic Acid Ether.—A. Weddige.—When the ether is treated with alcoholic ammonia there is formed cyan-ammonium-urethan according to the formula—

$$\left.\begin{matrix}CN\\ COOC_2H_5\end{matrix}\right\}+2NH_3=NH_4CN+\left\{\begin{matrix}NH_2\\ COOC_2H_5\end{matrix}\right.;$$

concentrated hydrochloric acid converts the cyan-carbonic acid ether, even in the cold, into oxalic acid and chloride of ammonium. When the free ether or its alcoholic solution is treated with sulphuretted hydrogen there is formed a crystalline, lemon-yellow-coloured substance, soluble in boiling water; fusion-point 63° to 64°. The formation of this body is elucidated by the following formula:—

$$\left.\begin{matrix}CN\\ |\\ COOC_2H_5\end{matrix}\right\}+H_2S=\left\{\begin{matrix}CSNH_2\\ |\\ COOC_2H_5.\end{matrix}\right.$$

By treating the cyan-carbonic-acid ether with sodium amalgam there is not formed a combination corresponding to kyanäthin.

Chemical Constitution of the Benzol Compounds.—Th. Petersen.—This monograph does not admit of abstraction.

No. 3.

Action of Potassium Sulphydrate upon the Aromatic Nitriles.—A. Weddige.—Pure cyan-benzyl, $C_6H_5OH_2CN$, was treated with an excess of an alcoholic solution of potassium sulphydrate, with the view of obtaining the potassa salt of the dithio-alpha-toluylic acid, $C_6H_5CH_2CS_7SK$; but instead of this, the result of the reaction was the formation of a body free from sulphur, and corresponding in composition to the alpha-toluylic acid amide, $C_6H_5CH_2CONH_2$: this substance is difficultly soluble in cold—more readily soluble in hot—water, readily soluble in alcohol, but very difficultly in ether; fusion-point, 154° to 155°; boiling-point, 181° to 184°.

Action of some Chlorides upon Sodium Alcoholate.—A. Geuther and F. Brockhoft.—This exhaustive monograph is divided into the following sections:—Pentachloride of phosphorus and sodium alcoholate; perchloride of ethylen and sodium alcoholate; perchloräthan and sodium alcoholate; trichlor-ethylen-chloride and sodium alcoholate; dichloräthylen-chloride and sodium alcoholate; monochloräthylen-chloride and sodium alcoholate; perchlormethan and sodium alcoholate.

Chemical Constitution of the Elementary Molecules.—Dr. H. Kolbe.

Observations on the Maxite and Leadhillite found in Sardinia.—H. Laspeyres.—This paper contains critical remarks on Bertrand's paper on this subject, published in the first number of the *Bulletin de la Societé Chimique de Paris* for this year.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xviii., No. 3, February, 1873.

Contains no chemical papers.

Revue Scientifique de la France et de l'Etranger, No. 48, May 31, 1873, and No. 49, June 7, 1873.

These two numbers contain no chemical papers.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 22, April 4, 1873.

This number again contains not a single chemical paper.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 7, June 12, 1873.

This number contains no original chemical matter.

MISCELLANEOUS.

Determination and Characteristics of Citric Acid.—Soluble citrates mixed with acetate of baryta, either hot or cold, produce a white amorphous precipitate, being citrate of barium with 14 aq. If, after precipitation, an excess of acetate of baryta be added, and the mixture heated in a water-bath, the precipitate becomes heavy and granular; it loses one-half of its water of crystallisation, and has now 7 aq. The presence of other organic acids does not interfere; the granular salt is absolutely insoluble in water, and citric acid may thus be easily determined. If the solutions are very dilute, they must be concentrated by evaporation, after additions of acetate of baryta, or the precipitate will consist of crystalline needles containing only 5 aq. Mr. J. Creuse, commenting upon M. Kammerer's paper, claims priority on the subject. He also states that M. Kammerer is in error in describing citrate of barium as insoluble in water. He contends that the citrate of baryta should be converted into sulphate before weighing, as it is very hygroscopic.

NOTES AND QUERIES.

Red-Coloured Magenta.—I have a sample of a colouring matter which appears like ordinary magenta, in a greenish golden cake soluble in water; but it dyes a brownish red tint, not at all like the salts of rosaniline. With hydrate of soda it gives a reddish precipitate or yellow if the alkali be in large excess, and a deep yellow solution. Can any of your readers inform me what this yellow solution contains, and how to utilise it? I believe the stuff is made from some residuum.—C. H.

New Ozone Generator.—Messrs. Tisley and Spiller send word that Mr. Wills stated, on commencing the reading of his paper at the meeting of the Chemical Society on the 5th of June (Chemical News, vol. xxvii., p. 292), that the generator was not his own contriving, but was manufactured by Messrs. Tisley and Spiller, and he thought it such an advance on all previous instruments as to deserve a proper notice of the Chemical Society.

Ilmenium.—Miller says that Hermann supposed he had discovered a new metal, but had since proved it to be a mixture of tantalic and columbic anhydrides. Dana ignores it, as do all the authorities I have access to. So I was not a little surprised to see the notice in the Chemical News, vol. xxvii., p. 59, of Hermann's monograph, giving atomic weight, oxides, and other particulars of ilmenium, when he was represented as admitting his former ides to be erroneous. Is Hermann the only authority for ilmenium, and are his views admitted by many chemists to be correct? If so, why has it not a place in modern chemistries?—Peter Jacobus.

Manipulation of Spongy Platinum.—In view of the fragility of the ordinary preparations of spongy platinum, as used for kindling gases, Professor Phin recommends the following capital plan:—"We have succeeded admirably with pumice-stone, which we first form into a cylinder of the proper size—say, 3-8ths of an inch in diameter—and then cut into discs about the 20th of an inch thick, by means of a fine saw. These discs are soaked for some time in a strong solution of bichloride of platinum in alcohol, and afterwards for an equal period in an alcoholic solution of sal-ammoniac. After being ignited, these discs inflame a jet of hydrogen readily, and we find that they retain their power quite as well as the more delicate forms in common use." *Handicraft.*

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society.* By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 81.—"I shall now proceed to take a review of the different series, for the purpose of pointing out such of them as may appear to be less deserving of confidence than the rest, on account of certain discordances which seem to impair their accuracy. I have already noticed that slight differences occasionally arise in the mean results. . . . But it is not to cases of this kind that I am now about to allude. . . . The case, however, is somewhat different with those experiments which, during any given series or course of operations, do not exhibit so regular and uniform a system; but, on the contrary, show evident signs of some disturbing force that has hitherto escaped detection, affecting not only the march and direction of the resting point, but also the time of vibration, thus impairing the accuracy, or at least the uniformity, of the results. The most remarkable instance of this kind occurs in the 33rd series . . . ; and it is worthy of notice that in this series there are no less than three experiments, where the arc of vibration *in*creased instead of being diminished: an evidence of some *extra*-disturbing force, which has baffled every effort of mine to unravel. Indeed one of the results, where this last-mentioned experiment is involved in the computation, makes the density" (of the earth) "as high as 9·150; but this rapid and enormous increase is partly assisted by a sudden change in the march of the resting point about that time, so that a variety of circumstances have here combined to produce this extraordinary result. And, astounding as this great quantity may appear, it should be noticed that one of the *single* results on the same day is as low as 4·292; so that by this counteraction the *daily* result is not so very materially affected. I am unable to throw any light on the cause of these and other discrepancies which occurred in this particular series. A similar instance, although not quite so discordant in magnitude, occurs in the 35th series. . . . . . We have here also one of the experiments exhibiting an *in*crease in the arc of vibration, and thus impairing the result in which its computation is involved. The last result likewise, in this series, is of very considerable magnitude, being as high as 7·425; but here also we have a *single* result on the same day as low as 4·113; so that, astounding as this quantity also may appear, yet by this counteraction the *daily* result is not sensibly affected."

P. 83.—"Other series might be adduced where the discordances between the single and daily results, although not so great as those already mentioned, evidently show that some disturbing force was in operation, which either escaped detection at the time, or against the influence of which it was found impracticable wholly to protect the apparatus. These cases have occurred mostly with the light balls, and when the torsion force . . . has been weak: and their effect has been exhibited by some irregularity in the march of the resting point, or in the time of vibration."

P. 83.—"But, even when discordances of considerable magnitude, of the kind above mentioned, do not occur, we yet find that the mean result of two several days (the mode of operation continuing the same in both cases) sometimes differ from each other by a greater quantity than might have been previously imagined . . . . which renders it manifest that we cannot always expect rigorous accuracy and uniformity in such delicate investigations, under all the various conflicting circumstances that occur in carrying on the operations."

MEETINGS FOR THE WEEK.

Monday, 23rd.—Royal Geographical, 8.30.
Wednesday, 25th.—Society of Arts, 4. Anniversary.
—— Geological, 8.
Thursday, 26th.—Royal Society Club, 6.30. Anniversary.
Friday, 27th.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

*** Vol. XXVI. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Errata.—Vol. xxvii., p. 262, for $C + \frac{b}{a}$ read $\frac{b}{a} \times C$.

R.—"High Farming without Manure," by G. Ville. This author has also published several valuable works in French on agricultural chemistry.

A Subscriber.—Consult Dr. Hassall's book on the subject.

SUPPLEMENT
TO
THE CHEMICAL NEWS.

VOL. XXVII. No. 708.

ON THE

DETERMINATION OF PHOSPHORIC ACID IN ALL PRODUCTS OF AGRICULTURAL AND PHYSIOLOGICAL IMPORTANCE.

By M. JOULIE.

(Continued from p. 230).

PART II.

THE author proceeds to give an account of the application of his "citro-uranic method" to a variety of cases.

Insoluble Phosphates (consisting chiefly of phosphate of lime, accompanied by carbonate of lime, silica, oxides of iron, alumina, fluoride, chloride, and iodide of calcium, and peroxide of manganese).—Whatever may be the composition of the mineral, the analysis consists of the following operations:—Sampling, solution, precipitation of the phosphoric acid in the state of ammoniaco-magnesian phosphate, and volumetric determination of the phosphoric acid contained in the precipitate.

1. *Sampling*.—This operation, simple as it seems, requires particular attention if comparable results are aimed at. If the phosphates are ground and in bags, a scoop is plunged into about twenty of them taken at random, and the contents are emptied upon a large sheet of paper. The whole heap is then thoroughly stirred and mixed together, and two or three 8-oz. bottles are filled with the powder. This operation should be performed in presence of the seller and the buyer, or their representatives, who both put their seals on the bottles, and sign, if needful, an account of the taking of the sample. One of the bottles is sent to the laboratory where the analysis is to be conducted; the others are reserved for verifications, if needful. The chemist who receives the sample registers the date of arrival, the professed nature of the sample, and the marks on the seals. The contents are then sifted upon a large sheet of paper; if any particles do not pass the sieve, they are powdered till the whole passes through. The mass is then mixed with a spatula, and then re-passed through a coarser sieve, and returned to the bottle. If the phosphates are unground (in the rock) the difficulties are greater. To obtain a product which shall fairly represent the average composition of the whole, about a hundred spadefuls are taken from different parts of the mass, and ground up in the crushing-mill. The powder is then carefully mixed and stirred together, and the bottles filled as above.

2. *Solution*.—(*a*). The simplest method is to weigh out 5 grms. of the sample, previously finely powdered, and introduce it into a flask marked at 100 c.c. It is first moistened with a little water, and 20 c.c. of nitric acid are then added. If the substance effervesces, the acid is only added by degrees, lest the liquid should boil over. When the effervescence has subsided, the flask is placed on a sand-bath, and heated for half an hour to a temperature close upon ebullition, and agitated from time to time. The flask is then cooled, by plunging it into cold water. When it is brought to the ordinary temperature, it is filled up to the 100 c.c. mark, and shaken, after having been closed with an india-rubber stopper. The contents of the flask are then thrown upon a filter, and the filtrate received in a wide-mouthed bottle provided with a ground stopper. During filtration it is well to cover the bottle and the funnel with a bell-glass to prevent loss by evaporation. This procedure requires little time, and is followed at present in many laboratories. It is very suitable in all cases where the phosphate is entirely soluble in dilute nitric acid. In such a case no error is committed by taking one-fourth or one-half of the solution, and supposing it to represent the same fraction of the weight of material originally taken; but, if the sample contains a certain quantity of insoluble matter, an error is committed proportional in importance to the quantity of insoluble residue.

(*b*). Wherever insoluble matter is present, the following method is preferable:—5 grms. of the sample are weighed out, and introduced into a flat-bottomed beaker; 20 c.c. of water are then introduced, and the whole shaken to moisten the powder. The beaker being then covered with a watch-glass, 20 c.c. of nitric acid are added with a pipette, the watch-glass being raised on one side with the point. If the effervescence is brisk, the acid is only introduced by degrees. When all the acid is introduced, and the effervescence has nearly subsided, the beaker is set upon the sand-bath, and kept for half an hour close upon ebullition, stirring from time to time. The watch-glass is then taken off the beaker, its under-surface washed with a stream of distilled water from the washing-bottle, the liquid stirred and allowed to settle. It separates into a sediment and a clear supernatant liquid. The clear portion is decanted into a flask containing 100 c.c.; boiling water is poured upon the residue. It is again allowed to settle, and the clear portion is again decanted into the flask, and so on till the liquid is no longer acid. This result is obtained before the flask is full. The liquid is then cooled, if necessary, and filtered. If two chemists operate upon the same sample, and the one prepares his solution by the method *a*, and the other by ordinary filtration, a difference of 4 to 5 per cent may easily arise from this cause. By using the process *b*, these sources of error cease.

3. *Precipitation*.—To precipitate phosphoric acid, we take generally 5 c.c. of the liquid. If the sample has left a large amount of insoluble matter, it may be supposed poor in phosphate, and in this case 10 or even 20 c.c. may be taken. This is run into a beaker, with the addition of 10 c.c. of the citro-magnesian liquid (this liquid should contain 400, and not 500, c.c. of ammonia at 22° B.) and a large excess of ammonia. The mixture is gently stirred with a glass rod. No immediate turbidity ought to appear; should this be the case, it is a proof that the quantity of citro-magnesian liquid is insufficient, and 10 c.c. more are at once added. It is stirred again when the precipitate of the double phosphate begins to appear. To ensure complete precipitation, the liquid should stand four or five hours, and preferably overnight. The deposit forms more quickly the less heat the liquids evolve on mixture, and the greater the excess of ammonia. As heating results from the combination of ammonia with the acids of the solution, it may be readily avoided by nearly neutralising the solution of phosphate with dilute ammonia *before* adding the citro-magnesian liquid, and in adding a large excess of ammonia.

4. *Volumetric Determination of the Phosphoric Acid*.—The precipitation being complete, the liquid is filtered, the precipitate is washed with water containing 10 per cent of ammonia, re-dissolved in nitric acid of the same dilution, neutralised with ammonia, mixed with 5 c.c. of the solution of acetate of soda, and titrated with the uranium solution as already directed. The amount of moisture should always be determined, and expressed in the report of the analysis along with the phosphate.

Bone Products and Manures.—In bones and their modifications—such as boiled bones, bone-ash, animal charcoals whether fresh or exhausted, precipitated phosphates, &c.—as well as in manures, natural or artificial, the determination of phosphoric acid is effected exactly as in natural phosphates. In some cases, water and organic

matter create special difficulties, and require particular manipulations.

Animal charcoal is often so damp, and so far from homogeneous, that no certain result could be obtained with a sample of 5 grms.; in such a case, 400 to 500 grms. must be taken, and the moisture in it must be determined by drying in the water-bath. The residue is then powdered, mixed, and sifted, and 5 grms. weighed out for the determination of the phosphoric acid.

Bones and many manures contain organic matter in greater or less quantity. These substances, besides shielding the phosphates from the solvent action of the nitric acid, render the solution so glutinous that the filtrations are rendered very tedious. For this purpose, 10 to 20 grms. are placed in a platinum capsule, and calcined at very low redness. Manures containing soluble phosphoric acid should never be ignited, as a part of the acid phosphate of lime may be reduced by the action of the carbon, and thus some of the phosphorus may be volatilised. If it is necessary to incinerate such manures, they should be previously mixed with their own weight of pure lime. The loss of weight during calcination must be carefully noted. The ash is then powdered, mixed, and 5 grms. are weighed out for the determination of the phosphate.

Determination of Phosphoric Acid in the Ash of Plants, in Soils, Dung, &c.

(*a*). *Ash of Plants.*—Phosphoric acid can be determined in the ash of plants by proceeding exactly as with natural phosphates, the precaution being taken to separate the silica. 2½ grms. of the ash are weighed out, placed in a porcelain capsule, moistened with a little water, and then treated with 10 c.c. of pure nitric acid, keeping the capsule covered with a watch-glass. When the effervescence has ceased, the capsule is set on the sand-bath, and kept covered. When the liquid begins to boil, it is uncovered, the bottom of the watch-glass is washed into the capsule by means of the washing-bottle, and the liquid evaporated to dryness. The residue is heated for half an hour, let cool, moistened with a little nitric acid, to which water is added after an hour; it is then boiled gently, and filtered, or decanted into a bottle marked at 50 c.c.

(*b*). *Soils.*—The sample, having been properly taken, is treated exactly as has been directed for the ash of plants, aqua regia being used instead of nitric acid. When the silica has been separated out and washed, the filtrate and washings are mixed, and evaporated down to about 35 c.c. We add now 10 c.c. of citro-magnesian liquid, and a great excess of ammonia. The mixture is now gently stirred; if an immediate turbidity appears, more citro-magnesian liquid is added to re-dissolve it, and the whole, after being well stirred, is set aside for twenty-four hours. At the end of this time, the phosphoric acid will be found entirely deposited in the state of double phosphate. If the soil is very poor, 20 or even 50 grms. may be taken. It may happen that, in soils produced from the decomposition of felspar, the whole of the phosphoric acid may not be extracted by aqua regia; in this case, the residue, after treatment with this solvent, is fused with a mixture of carbonates of soda and potassa, dissolved in hydrochloric acid, and, after separation of the silica, phosphoric acid may be again sought for in the liquid. It must be remembered that phosphoric acid in so insoluble a state is not of the slightest agricultural value.

(*c*). *Dung.*—500 grms. of the sample are weighed out, dried in the water-bath, and incinerated in successive portions.

(*d*). *Waters.*—Before attempting the quantitative determination of phosphoric acid in waters, a qualitative test should be applied. Add to the water a little perchloride of iron, and precipitate with ammonia. Let the precipitate stand to collect for twenty-four hours, decant off the clear liquid, re-dissolve the precipitate (which contains all the phosphoric acid) in a little hydrochloric acid, evaporate to dryness, and heat to 250° C. for thirty minutes to separate out silica. Re-dissolve in hydrochloric acid and water, filter, and add Sonnenschein's molybdic solution. If a yellow precipitate or a yellow colouration appears, the quantitative process may be begun. 10 litres of water are evaporated down to 1 litre. Hydrochloric acid is added to the still warm liquid in quantity sufficient to re-dissolve any deposit formed; then a few drops of perchloride of iron and ammonia in slight excess. All the phosphoric acid is thrown down along with the iron. The clear liquid is decanted off, the precipitate collected on a filter, washed, re-dissolved in a little hydrochloric or nitric acid, and 5 c.c. of the citro-magnesian liquid and an excess of ammonia are added to the liquid. The analysis is then completed as above directed.

Superphosphates.

The amount of phosphoric acid existing in a soluble state in a manure may be found by dividing the amount of "neutral phosphate of lime made soluble" by 2·18. The solution of a soluble phosphate is a double process. For the aqueous solution, containing the soluble phosphoric acid, we weigh out 5 grms. of the sifted sample; it is put in a glass holding about 125 grms., covered with a little distilled water, and stirred up with a glass rod flattened at the end, so as to form a thin paste; 20 c.c. of cold distilled water are then added, the whole stirred up, and left to settle. The turbid liquid is poured into a flask marked at 100 c.c., and 10 more c.c. of distilled water are put upon the sediment, until the flask is filled and the phosphoric acid is completely extracted. When this process is at an end, the last washing should no longer redden litmus-paper. The turbid solution is then filtered, under a bell-glass if needful.

The acid solution, containing, of course, the total phosphoric acid in the sample, is prepared by putting 5 grms. of the sample in a beaker, adding 5 grms. of pure nitric acid, digesting on the sand-bath, adding water, and exhausting as above. Each of these two solutions is then analysed separately as directed above. The amount of soluble phosphate deducted from the "total," as found in the acid solution, gives the quantity present in the insoluble state.

(To be continued).

FRESENIUS'S JUBILEE DAY.*

FRIDAY, May 3rd, being the twenty-fifth anniversary of the foundation of Fresenius's Laboratory, at Wiesbaden, there was, on that day, one of the most pleasing spectacles it has been my lot to witness. The large hall in which the jubilee ceremony took place was speedily filled. The greater part of the company consisted of the former and present students of Fresenius; there were also present officials of the state, as well as deputations from the various universities and scientific societies of Europe.

The ceremony was opened by a speech from Dr. Fresenius, giving an account of the erection and progress of his Laboratory. I will here endeavour to give a short account of this man's career. Dr. Remigius Fresenius was born in 1818, at Frankfort-on-the-Maine, where he passed the early years of his life. In 1840, he studied at the university of Bonn under Dr. Claud Marquart, from thence he removed, in 1841, to Liebig's Laboratory at Giessen, where he remained until the end of 1843, during which time he occupied the position of student, private assistant, and Government assistant at the above-mentioned laboratory. It was during his stay there that he published his first edition of "Chemical Qualitative Analysis."

About 1845, in answer to a call from the Nassau Government, he removed to Wiesbaden, where he commenced giving lectures on Chemistry, in the palace of the then reigning Duke of Nassau, who fully recognising

* Communicated by one of his Students.

his great abilities, was the means of helping Fresenius to erect this laboratory which has sent out so many good chemists, and established the reputation of their teacher as one of the most eminent analysts of the present day.

Fresenius's speech being ended, the President of the Duchy of Hesse Nassau, on the part of the Emperor, presented him with the Gold Medal for Science. From the Imperial Prince and Princess he received a laurel wreath, together with an autograph letter from the latter, which ran as follows:—

"On this your jubilee day, accept the hearty good wishes of myself and the Crown Prince. We take a sincere interest in this happy event, and beg you to accept, in remembrance of it, our enclosed portraits, and hope that they may find a place in that same room where you have received us so kindly. In conclusion, let me add my earnest wish, along with those that will be so loudly expressed to-day, namely, that you may be spared for many years hence both to Science and the Fatherland. "Victoria,

"Crown Princess."

After this, the Students' Gift was presented to Fresenius. It consisted of three elegant albums, containing the portraits of his former and present pupils. Along with these was a silver fruit dish, with a Minerva statuette on the top. The whole was supported on a marble pedestal, on which was inscribed these words:—"To Privy Councillor Professor Dr. Remigius Fresenius, from his grateful students, in remembrance of the twenty-fifth year of the foundation of the Chemical Laboratory of Wiesbaden." Then came various congratulatory addresses from this town, and also from several scientific societies of Europe.

The ceremony was closed by a speech from Professor Neubauer (who is well known in England by his book, "Analysis of the Urine.") In the afternoon there was a grand dinner given to Fresenius, where more than 200 persons sat down, when his health was drunk with enthusiasm.

In closing the account of this memorable day, I only repeat the wish of all who know this great man, in saying that it is our earnest wish that his life may yet be spared for many years to come, to reap the fruit of his arduous labours.

NOTICES OF BOOKS.

Fourth Annual Report of the State Board of Health of Massachusetts. January, 1873. Boston: Wright and Potter.

It was once humourously remarked by a wicked German author that every Englishman was insane upon two questions—sanitary reform and the conversion of the Chinese. We are happy to find that the former craze, if craze it be, is spreading; public health is studied as diligently, and, to say the least, as wisely, in the United States as in England. Nor is this surprising; the same causes that have polluted the air and the waters of England are actively at work on the other side of the Atlantic. The compilers of the Report before us look forward to the day "when we shall reach the state of things at present existing in the manufacturing districts of England." "Some of the brooks which were but recently pure and undefiled are now polluted so that neither man nor beast will drink freely of them; and this change is insidiously taking place from year to year." The apathy still prevailing among a large and influential portion of the unscientific community is duly estimated:—"The temptation to cast into the moving waters every form of portable refuse and filth to be borne out of sight is too great to be resisted. It is felt as strongly by municipalities as by individuals. What becomes of this refuse lower down the stream is a matter of little concern. It is got rid of, at any rate." It is consolatory to find that our English corporations, and, to sound a still lower depth, our metropolitan vestries, do not monopolise all the selfishness and un-wisdom of the world. The "parochial mind," it appears, clings everywhere to its characteristic vices.

A mere glance at the contents of this Report will convince the reader of its value. We have an elaborate and exhaustive paper on "Sewerage, Sewage, the Pollution of Streams, and the Water Supply of Towns"; an analysis of evidence on "Beershops and Prohibitory Laws"; a report on the "Character of Substances used for Flavouring Articles of Food and Drink"; a paper on "Drainage for Health"; an essay on "Infant Mortality"; a chapter on the "Food of the People of Massachusetts"; a "Report on the Adulteration of Milk"; the results of a correspondence on the "Antecedents of Pulmonary Consumption"; a paper on the "Adulterations and Impurities of Food"; remarks on the "Homes of the Poor in our Cities"; a report of the "Butchers' Slaughtering and Melting Association"; and, finally, a paper on the "Health of Towns." Many of these reports treat of subjects not within our cognisance; others put forward, occasionally, views from which we most emphatically dissent, but all are the work of able, thoughtful men, and are evidently the result of research equally comprehensive and minute.

In the section on the disposal of sewage and the pollution of streams, we find the evils of neglect and the respective advantages of the "earth-closet" and the "water-closet" system very fairly stated. The ventilation of drains, the circumstances under which sewer-gases may, in spite of traps, find their way into human dwellings, the disposal of manufacturing refuse and of kitchen slops, the construction of sewers and their outlets, are all explained and described.

The feeblest portion of the Report, and, indeed, of the whole work, is the account of the various processes for the treatment of sewage adopted or proposed in England. The author, instead of depending upon his own judgment, appears to have swallowed the "Report of the Royal Rivers' Pollution Commission," "with all its blushing errors thick upon it," and without the proverbial, and, in this case, most necessary, grain of salt." To this he superadded the "Report of the British Association Committee on the Treatment and Utilisation of Sewage," and Dr. Corfield's most excellent work on the same subject. After such a course of reading, no fair estimate of the comparative merits of precipitation and irrigation could be expected. The simplicity which can still quote, in unquestioning faith, such assertion as that "The manipulations required for the extraction and drying of the A B C Company's manure are attended with a nauseous odour, and would occasion a serious nuisance if the works were situated in or near a town," and which can speak of previous sewage contamination "as a definite, determinable entity," is most refreshing. We should have given Massachusetts credit for more shrewdness. It is, however, satisfactory to find that all the analyses of waters executed for the State Board of Health have been performed by the process of Messrs. Wanklyn and Chapman, and not by that of the gentleman whom the authors characterise as "the most eminent chemical authority on the sewage question."

The following statement appears to us very questionable:—"There can be no doubt that the very extensive (almost universal) use of alcoholic drinks as an ordinary daily beverage of all classes and conditions, and of both sexes, in England, is due in part to the fact that water of unquestionable purity is so very difficult to obtain." We see no evidence that the relative consumption of alcoholic liquids is smaller in towns supplied with pure water, such as Manchester, Glasgow, or Halifax, than it is in London.

If the people of Massachusetts are about to take the prudent step of excluding polluting matter from their streams and lakes, we would beg to suggest the following

standard :—That nothing should be allowed to flow into a river containing a greater amount of putrescible impurity than does the water of the river itself. They would do well, also, in legislating concerning manufacturing refuse, to exclude copper, lead, chrome, &c., as stringently as arsenic, and not place these poisonous metals on the same footing as the comparatively innocuous iron and aluminium. Whilst unable to afford at present more space to the examination of this work, we must pronounce it a storehouse of important information, and strongly recommend its perusal to all sanitary reformers.

Manual of Chemical Analysis as applied to the Examination of Medicinal Chemicals. By F. Hoffmann, Ph.D. New York: D. Appleton and Co., Broadway.

General treatises on chemical analysis, however ably compiled, though still necessary, are no longer sufficient for the wants of the age. Each class of chemical investigators requires a separate and especial code of instructions. The agricultural chemist, the colourist, and the metallurgist have for some time enjoyed the advantage of works of this nature. It is therefore with great satisfaction that we note the appearance of the present manual especially adapted to the requirements of the pharmaceutical chemist and the manufacturer of medicinal chemicals.

The first part of the work gives an account of the needful reagents and apparatus to be employed, with a brief systematic course of qualitative analysis and of volumetric operations. The second part enumerates the chief pharmaceutical chemicals in alphabetical order, pointing out the impurities and sophistications to which each is liable, and the most approved methods for ascertaining its quality. As a rule the processes recommended have been judiciously and carefully selected. The instructions for distinguishing the organic bases from each other, and for determining the amount of the more important,—such as morphia and quinine contained in commercial samples of the raw materials,—are full and trustworthy.

Some of the illustrations, we cannot help saying, are most needlessly repeated. Some of the synonyms of every substance are given, but this useful feature of the book might, with advantage, have been made more complete. The work concludes with tables for the reciprocal conversion of metric and troy weights, and with a very elaborate index. We hope that its circulation, on both sides of the Atlantic, may facilitate the detection both of adulterations and of the impurities resulting from negligence, and hence tend to make these evils less plentiful.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture or composition of fuel. Langley Banks, 127, Campbell Street, Kingston-upon-Hull. November 12, 1872.—No. 3362. The invention relates to the combination of the following matters:—1st. The refuse which accumulates round the mouths of coal-pits. 2nd. Small coal. 3rd. Turf, peat, or such like matter. 4th. Mineral pitch. 5th. Coal-tar. 6th. The scum or refuse from cotton seed after obtaining oil-cake therefrom. The coal-tar and the mineral pitch are prepared by being mixed whilst hot and after being boiled in the ordinary manner in equal proportions. The two are then run together; before use they are re-boiled and mixed with the other ingredients before named. The whole are then compressed together by steam-power or otherwise, and the composition is then ready for use.

Certain improvements in the treatment of night-soil and other refuse matter. Gustav Alsing, civil engineer, 3, Bank Place, Preston, Lancashire. November 15, 1872.—No. 3412. For the purpose of fixing the ammonia contained in night-soil, sewage, or other refuse matter used as manure, or otherwise, and at the same time solidifying the said night-soil, sewage, or other refuse matter so as to render it in a convenient state for transport and immediate use I mix it with a proportionate quantity of sulphate of lime, commonly called gypsum or plaster-of-paris.

Improvements in the manufacture of steel and malleable iron, and in furnaces therefor. Friedrich Hahn, professor of chemistry, Berlin, Germany. November 16, 1872.—No. 3417. In manufacturing steel and malleable iron according to my improved process, I first melt the iron ore or pig-iron and cause the molten cast-iron to descend through a chamber or passage which is supplied with heated air by a suitable blast, and in passing through the heated air the crude metal is fully exposed thereto, and being acted upon by the oxygen in the same is thereby decarburised and also freed from the various impurities usually existing in iron ore or pig-iron.

A new or improved varnish. Thomas Bagley, varnish maker, Birmingham. November 16, 1872.—No. 3421. This new or improved varnish has the following composition:—40 lbs. of damar gum, 10 lbs. of copal gum, 3 lbs. of kowrie gum, 84 lbs. of common resin, 20 lbs. of superfine resin, 16 lbs. of chloride of sodium, 51 lbs. of oil of turpentine, 51 lbs. of resin spirit, 570 lbs. of benzoline. In mixing and incorporating the materials the gums and the chloride of sodium are first melted and the resin afterwards added thereto. The mass having cooled to about 110° F., the resin spirit is added, and the temperature having been further reduced, the turpentine is added, and the temperature having been still further reduced, the benzoline is added, the several ingredients being thoroughly incorporated together. The varnish is then strained to complete its manufacture. This varnish hardens very rapidly, and is especially useful for varnishing metallic articles to prevent rusting or corrosion, but may also be applied to non-metallic articles, and to various other purposes.

Improvements in treating fatty materials in combination with various kinds of pitch, alkalies, and oil, also in the treatment of animal, vegetable, and mineral oils for lubricating purposes. Robert Hornby, manufacturer, Marchmont Street, Middlesex. November 19, 1872.—No. 3445. The novelty of my invention consists in the amalgamation of the ingredients for lubricating purposes, and in the use of steatine or other earthy substances as a lubricant for railway-carriage and other axles.

An improved apparatus for and method of treating wood and other similar substances for the manufacture of half-stuff and paper. Carl Dietrich Julius Seitz, analytical chemist, Edinburgh. November 19, 1872.—No. 3446. Wood is boiled in a vessel through which a constant circulation of heated caustic soda lyes is effected by a pump placed between and connected to the wood-boiler and a heater.

Improvements in the preparation of autographic tracing-paper and in the fluid employed in connection with the same. Charles Ladislas Siecinoski, 1, Taplow Cottages, Balham, Surrey. November 19, 1872.—No. 3451. The invention is based on the principle of the reaction of chromates on gelatine, gums, and albumen, and consists in the preparation of an autographic tracing-paper and an improved ink for writing or drawing on the same in order that the said writing or design may be transferred immediately or at any subsequent period.

An improved method for purifying and amalgamating gum resins, including kauri gum. Alfred Morgan, merchant, 258, South Lambeth Road, Surrey. November 20, 1872.—No. 3460. Pulverising the gum in order to extract from it the foreign substances held in combination with it. The use of chloride of lime in solution for separating from the gum the woody particles and foreign substances usually found in it. The use of moist or wet heat and pressure for amalgamating the powdered or small gum preparatory to use.

Improvements in deodorising and purifying sewage and other excrementitious matters and in obtaining certain useful products therefrom. Edwin Hills, manufacturing chemist, Warsash, Southampton, and Benjamin Biggs, merchant, 3, Laurence Pountney Hill, London. November 20, 1872.—No. 3464. This invention consists in treating sewage, night-soil, and other excrementitious matters so as to deodorise and purify them and to obtain ammonia and sulphur as residual products. According to one process the matters to be treated are mixed with lime in an air-tight tank. Air is then forced through the said matters, thereby precipitating the solid parts. The said air is then conveyed to a second tank carrying with it sulphuretted hydrogen and ammoniacal gases. This second tank contains sulphurous acid, through which the aforesaid gases are passed, and sulphite of ammonia and sulphur are thus obtained. Or the aforesaid gases may be passed through sulphuric or muriatic acid in the second tank to fix the ammonia and the sulphuretted hydrogen, and other uncondensed gases are afterwards passed through sulphurous acid or through hydrated oxide of iron contained in a third tank to decompose the sulphurous hydrogen and obtain sulphur. The sewage precipitate in the first tank may be used as a manure. According to another process the matters to be treated are placed in an air-tight tank and sulphurous acid forced through them to precipitate the solid parts and fix the ammonia and decompose the sulphuretted hydrogen and obtain sulphur therefrom. The sewage precipitate or sludge thus obtained may either be dried and used as a manure or it may be burnt so as to cause it to give off its sulphur in the form of sulphurous acid gas or be otherwise utilised.

Improvements in the manufacture of steel. Peter Jensen, engineer and patent agent, 89, Chancery Lane, Middlesex. (A communication from Thomas Brooks, Minerva, Ohio, U.S.A.). November 21, 1872.—No. 3477. According to one arrangement the ingredients are by preference taken in the following proportions, viz:—74 lbs. of bar iron, 14 ozs. of tungsten, 8 ozs. of charcoal, 3 ozs. of manganese, 8 ozs. of fluor-spar, or chlorophane, and are treated as usual in a smelting-pot. When a finer quality of tool welding steel is required, 2½ ozs. of calcium tungstate is substituted for the tungsten. In producing a "file steel" he uses by preference about 74 lbs. of "Bessemer" scrap or rail bar, 1½ lbs. of cast-iron, or 2 lbs. of fluor-spar, or chlorophane, ½ oz. of manganese, 1½ ozs. of charcoal, 1 oz. of bismuth, and the same is treated in a smelting-furnace. In some cases 74 lbs. of wrought bar-iron, 14 ozs. of tungsten, 14 ozs. of spiegeleisen, 8 ozs. of charcoal, ½ oz. of black oxide of manganese are employed and treated as usual in a crucible. Steel thus produced will weld without the usual chemicals employed for that purpose, will make tools capable of receiving clean sharp edges, and be perfectly malleable and tough. In the above processes the inventor prefers to use Swedish roll bar of the KB brand.

THE CHEMICAL NEWS.

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ON THE REDUCTION OF PURE ANHYDROUS SESQUIOXIDE OF IRON WITH PURE CARBON IN VACUO.

By JOHN PARRY,
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BEYOND the mere fact that carbon, in contact with the oxide of iron at a red heat and upwards, reduces the latter to the metallic state, we have little or no information as to the part which carbon takes in the reduction of oxide of iron. It has been shown by the author's previous experiments, and by others, that carbon most carefully prepared by the ordinary methods still contained volatile matter capable of evolving gas under suitable conditions, *i.e.*, on heating *in vacuo*, or on being brought in contact at a red heat with oxides; hydrogen combining with oxygen to form water, and the remaining gases form other gaseous compounds with oxygen, the solid carbon being also taken up by the oxide in contact with it. Taking this view of the matter, it may be said the decomposition of sesquioxide of iron by the direct action of carbon only has never yet been achieved.

It occurred to the author that this might be done *in vacuo*, taking suitable precautions to secure sesquioxide of iron and carbon free from gas of any kind.

The mercury air-pump offered a ready means of doing this; and accordingly pure sesquioxide of iron and carbon were made by Mr. E. H. Morton, F.C.S., as follows:—

Pure sesquioxide of iron was prepared from pure oxalate of iron; the dried salt was heated in a combustion-tube, in a current of purified hydrogen, until complete reduction took place. The metallic iron obtained had a steel-grey colour. It was dissolved in hydrochloric acid, oxidised, and precipitated by ammonia. The precipitate was well washed a great number of times with boiling water, dried at 100°, then ignited. This was found to be quite pure, with the exception of a trace of sulphur.

Preparation of Carbon free from Volatile Matter.—This was made from white sugar, first heated until all evolution of gas had ceased, then in the full heat of a gas blowpipe, next fusing heat of iron, and lastly *in vacuo*, and kept in well-stoppered bottles.

The object being—(1) To ascertain, experimentally, that on heating carbon in contact with sesquioxide of iron, the latter was reduced; (2) the temperature at which reducing action commenced; (3) the rate of reduction at known temperatures: (4) quantity and kind of gas evolved at various degrees of heat. The author proceeded as follows:—

Expt. 1.—1 grm. of sesquioxide of iron mixed with 0·25 grm. of carbon was placed in a glass tube closed at one end, the other being drawn out and attached to the pump with water-joint, as shown in Frankland and Armstrong's memoir (*Chemical Journal*, vol. vi., p. 90). A vacuum being first formed in the cold, the part of the tube containing the mixed sesquioxide of iron and carbon was placed in a vessel of water, which was then heated to boiling; no gas was evolved, showing that the temperature was insufficient. The tube was next placed in a bath of fused lead, gas was slowly evolved, and in 7·30 hours 3·3 c.c. of gas was collected (B 760 temp. O deg.), which contained 87·2 per cent carbonic acid, equal (the number of c.c. of oxygen in 1 grm. Fe_2O_3 being 209·834 c.c.) 1½ per cent nearly oxygen evolved.

Expt. 2.—The amount of carbon required for the conversion of the oxygen contained in 1 grm. of sesquioxide of iron into CO_2 being 0·1146 grm., 1 grm. of sesquioxide of iron was mixed with 0·13 grm. of carbon, the carbon and oxide were well mixed with a spatula on a sheet of glazed paper, and transferred to a porcelain tube, the mixture being about the centre. The posterior end of the tube was closed with a well-fitting dry cork coated with melted sealing-wax, and thereby rendered impervious to air. The other end of the tube was connected with the pump by means of a pierced, well-fitting, india-rubber cork and glass tube, the cork being coated with a thick varnish. Thus arranged, on pumping, the vacuum was found to be perfect, the whole being kept *in vacuo* for twelve hours previous to heating. For heating, a small gas blast-furnace was fitted up, in which the tube was laid, the part containing the mixed carbon and sesquioxide of iron being placed so that the blast gas flame should play exactly upon the part containing the mixture.* By regulating the gas and air any desired temperature could be obtained and maintained; the temperature being estimated by putting small rods of different metals in the gas flame, regulating the supply of gas and air so as to just fuse the metals in the flame, it being assumed that the tube and its contents in the same flame had an equal temperature.

At a heat rather above the fusing-point of zinc, but *below* that of brass, 53·52 c.c. of gas were evolved in 7 hours 10 minutes, containing 37·15 c.c. CO_2 16·37 CO = 45·335 oxygen taken up from 1 grm. of sesquioxide of iron, or 21·605 per cent. At the end of 7 hours and 10 minutes the gas had all but ceased coming off, and only a few bubbles were collected on further heating for three hours.

The heat was now raised to *bare* fusing of brass. Gas was evolved, as nearly as could be estimated, at the rate of 5 c.c. per hour for 1 hour 15 minutes.

The heat again raised, brass readily *fused*, but not copper. Gas came off at nearly three times the previous rate; at the end of two hours it had nearly ceased. The heat was continued for one hour longer, but very little gas was evolved.

Heat was now raised to nearly fusing-point of copper. At this temperature gas was rapidly evolved, and for the first 3 hours and 25 minutes came off without the aid of the pump; after this the pump was required to collect the gas.

Total gas in ten hours, temperature rising from bare fusion of brass to *bare* fusing of copper, 51·273 c.c. CO_2 130·547 CO = 116·546 c.c. oxygen, taken up from Fe_2O_3.

The total number of c.c. gas evolved in 17 hours 10 minutes was 235·34, of which 88·423 was CO_2, and 146·917 CO, equal 161·881 c.c. oxygen from the sesquioxide of iron, leaving only 47·953 oxygen still in combination.

These experiments show—first, that at low temperatures the reducing action of carbon is slow, also that such action is not long continued; after a certain time it practically ceases altogether; but it is also clear that at low temperatures an economy of carbon is effected, the temperature not being sufficient to convert the carbonic acid first formed into carbonic oxide. Nevertheless, it is shown that, even at low temperatures a considerable amount of oxygen is liberated; thus, in 7 hours 10 minutes, nearly 22 per cent of the total quantity was evolved, and when it is considered that in reduction operations on the large scale this may be considered a comparatively short time, the reducing action of carbon on sesquioxide of iron, even at low temperatures, deserves consideration. The after trials, at temperatures below the fusing-point of cast-iron, also show that the reduction of sesquioxide of iron by solid carbon is *rapidly* effected. Altogether, the time, 17 hours 10 minutes, required for the evolution of 75¼ per cent oxygen is less than the time usually taken by iron ore in its descent from the top to the bottom of the blast-furnace; but it must be remembered that the *whole* of the *ore* cannot be said to be in contact with carbon in the blast-furnace, and consequently this only applies in a modified degree to the blast-furnace.

* Both ends of the tube kept cool with a small stream of water constantly running.

The author, however, wishes this to be considered as only a preliminary paper. It is intended to carry out these experiments *in vacuo* in a more complete manner, and the exact effect due to temperature will be thoroughly tested by heating weighed sesquioxide of iron and carbon in fixed baths of the metals and their alloys, from the fusing-point of zinc to that of cast-iron, taking the time required until action ceases, the amount and composition of the gases evolved, from which the amount of oxygen taken up can be readily calculated.

It is also intended to carry out a similar series of experiments with various kinds of iron ore.

Next, to test the action of carbon on Fe_2O_3 in—(1) an atmosphere of CO_2; (2) of CO; notably the latter, in order that the results may be compared with those *in vacuo*.—*Journal of the Iron and Steel Institute.*

ON THE

DETERMINATION OF PHOSPHORIC ACID IN ALL PRODUCTS OF AGRICULTURAL AND PHYSIOLOGICAL IMPORTANCE.

By M. JOULIE.

(Concluded from p. 310).

Part III.

To be assimilable, phosphates must be soluble in the water of the soil. But, except the acid phosphate of lime, all calcic phosphates are insoluble, or nearly so, in pure water. Even the acid phosphate is soon converted into a neutral salt by the lime in the soil. But the water in the soil is not pure, but charged with carbonic acid, and is thus able to dissolve the neutral, and even the tribasic, phosphate of lime when recently precipitated. The water in soils contains, further, salts which all, more or less, promote the solution of phosphate of lime. The humus contained in the dark coloured soil of heaths and woodlands attacks phosphates energetically; this is in part due to the presence of acetic acid in humoid matter, as proved by Déhérain. The assimilability of a phosphate depends on the greater or less ease with which it is attacked by the solvents just mentioned, and also on the class of solvents which it finds in any given soil. Thus, Ardennes phosphate, well ground, is assimilable with ease in recently-cleared woodlands, but useless in chalky soils where humus is wanting; hence, the value of a phosphate cannot be stated without an exact knowledge of the soil where it is to be employed. Agricultural practice recognises in recent bones more general applicability than in fossil phosphates; hence, they bring a higher price per unit. Spanish apatite in fine powder, though far richer in phosphoric acid than the phosphatic fossils of the Ardennes, is less efficacious; hence, the mere percentage of phosphates cannot determine the value of a phosphatic mineral. Hence, the rich mineral phosphates are now almost exclusively devoted to the manufacture of superphosphate; the fossil phosphates of the Ardennes are used upon newly-cleared woodlands; whilst recent bones are applied with success to all soils. These differences depend on the state of aggregation. If phosphates are treated with an energetic solvent, like hydrochloric or nitric acid, all dissolve readily. With sulphuric acid there is a marked difference in their behaviour, whilst acetic acid separates them into two great classes. Apatites, phosphorites, and coprolites yield to this acid merely a little carbonate of lime and a trace of phosphate. Bone-products are attacked, though much less completely, if they have been ignited. Pure tribasic phosphate, recently precipitated and air-dried, dissolves almost entirely, but, if previously calcined, only about one-half is soluble. The author determined the most favourable conditions for the action of each reagent upon phosphates, and then allowed them to act under these conditions upon a series of normal phosphates which had been previously carefully analysed. The analysis of the products of the reaction enabled him to find precisely the degree in which each had been attacked. The two reagents selected were oxalate of ammonia and acetic acid. The phosphate most easily acted on, with the exception of the soluble acid phosphate, is the neutral salt obtained by the double decomposition of chloride of calcium and phosphate of soda in dilute solutions; it contains—

$$\left.\begin{matrix}2CaO\\HO\end{matrix}\right\} PO_5+4HO.$$

It does not lose its crystalline water below 115°, and can therefore be dried at 100° without decomposition. This phosphate was taken as a standard of assimilability. By boiling oxalate of ammonia it is almost entirely converted into oxalate of lime and phosphate of ammonia. The following proportions were most favourable:—

Powdered and sifted phosphate ..	0·5 grm.
Crystalline oxalate of ammonia ..	2·0 grms.
Distilled water	150 c.c.

The whole was placed in a flask marked at 200 c.c., and boiled gently for two hours on the sand-bath, cooled, and filled up with distilled water to 200 c.c. The amount of phosphoric acid dissolved was found to be 96·85 per cent of the entire proportion present. The acetic acid used was commercial pyroligneous acid, containing 428·72 grms. of $C_4H_4O_4$ per litre. Its action upon phosphate of lime was rather hindered by heat; hence, the experiments were made at ordinary temperatures. Half a gramme of the phosphate to be examined, powdered and sifted, was placed in a flask, mixed with a measured volume of the pyroligneous acid, and shaken up. The mixture is let stand for four or five hours, with occasional shaking, and filtered. A known volume of the clear liquid is mixed with excess of ammonia. If no precipitate is formed, it is a proof that no phosphate has been dissolved; if a precipitate is formed, it is re-dissolved. To dissolve completely half a gramme of the neutral phosphate, 50 c.c. of the acid are required. All the other phosphates were treated with the same proportion and under the same conditions. A numerous series of phosphates were then submitted to these reagents. No. 1 was the neutral phosphate above mentioned. No. 2 was a precipitate formed by adding excess of ammonia to the hydrochloric solution of bone-ash, washing with much water, and drying in the air. It contained—

Phosphoric acid	24·00
Lime	28·80
Loss on ignition	47·20
	100·00

In pure tribasic phosphate, the lime would be only 28·32; the precipitate contains, therefore, lime in excess, as always happens when phosphate of lime is thrown down by ammonia in presence of excess of lime salts. The loss on ignition is water. No. 3 was a tricalcic phosphate obtained under different conditions. Bone-ash was dissolved in hydrochloric acid, precipitated with ammonia, washed by decantation, re-dissolved in acetic acid, boiled, and partially evaporated. An abundant deposit was formed, which was washed in much water, dried at 100°, and powdered. It contained—

Phosphoric acid	40·31
Lime	46·40
Loss on ignition	11·60
Chlorine..	1·22
Loss	0·47
	100·00

No. 4 is the same after prolonged ignition, and containing 44·364 of phosphoric acid. These phosphates are all unequally attacked by oxalate of ammonia, and all less than the neutral phosphate. The results were—

Designation.	Phosphoric Acid. In 100 kilos. of sample.	Dissolved for 100 parts of Phosphate experimented on.	Dissolved for 100 parts of Phosphoric Acid present.
1. Neutral phosphate ..	39·04	37·77	96·85
2. Tricalcic phosphate, precipitated in the cold, and air-dried..	24·00	24·80	90·83
3. Tricalcic phosphate, precipitated from a boiling acetic solution	40·31	28·18	69·90
4. Tricalcic phosphate calcined	44·36	23·94	53·96

Acetic acid acted less energetically, but in the same relative order.

Nos. 5 and 6 are phosphates from two manufactories of gelatine, obtained by dissolving in dilute hydrochloric acid, and precipitating with lime. No. 7 is a solution of a mineral phosphate precipitated in the same manner. The results were—

	Percentage of Phosphoric Acid in the sample.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
5.	36·26	34·12	94·09	26·23	72·35
6.	32·00	26·35	82·46	25·67	80·22
7.	37·05	21·84	58·98	12·95	34·95

The order of solubility of Nos. 5 and 6 is here not the same for the two reagents, whilst No. 7 shows an unexpected inferiority. Careful experiments with mineral phosphates precipitated in the laboratory, proved that this result was due, not to the origin of No. 7, but to its mode of preparation: hence, the manufacturer of precipitated phosphates can always check the value of his methods by ascertaining the solubility of the products in oxalate of ammonia and in acetic acid. Powdered bones freed from gelatine, animal charcoal, and bone-ash were next examined. Their solubility was likewise found to diminish in proportion to the elevation and duration of the temperature to which they had been submitted.

Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia. Phosphoric Acid Dissolved in 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved in 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved in 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved in 100 parts of Phosphoric Acid present.
8. Powdered bones free from gelatine	30·00	20·38	67·93	24·00	80·00
9. Animal charcoal	29·40	12·85	43·70	16·00	56·53
10. Bone-ash	34·56	11·62	34·98	8·37	24·21

Guanos.

Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
11. Guano from Guanape..	20·27	17·56	86·66	16·89	83·33
12. Bolivian ..	27·32	12·38	45·34	14·64	53·58

Hence it appears that, if the Guanape guano is poorer in phosphates than the Bolivian, it has the advantage in solubility and assimilability.

Phosphates of the Green Sand.

Name of Sample.	Percentage of Phosphoric Acid in the sample.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
13. Phosphate from the Ardennes (rich) ..	23·61	8·09	34·26
14. Phosphate from the Ardennes (poor) ..	18·88	5·74	30·40
15. Russian (green and poor)	14·86	4·50	30·27

On these phosphates, acetic acid has no action. Oxalate of ammonia places them between animal charcoal and bone-ash, the exact rank which agricultural practice assigns them.

Phosphates from the Departments of Lot, Aveyron, Tarn, and Tarn and Garonne.

Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
16. Agatised phosphate; hard; powder pale yellow	34·50	8·72	24·60	9·55	27·60
17. Concrete; soft; powder deep yellow	16·80	5·70	33·93	5·74	34·17
18. Similar sample from another mine	20·70	6·40	30·91	5·85	28·76
19. Concrete; white and soft; powder white	31·80	6·75	21·24	6·53	20·53
20. Agatised; blue and hard; powder grey..	35·60	7·08	19·88	6·75	18·96
21. Concrete; brown and soft; powder brown	21·60	3·38	15·62	2·47	11·46

These phosphates belong to the same formation, but they are mixed with variable quantities of foreign matter—such as carbonate of lime, ferruginous clay, and oxide of manganese—which modify their state of aggregation, and consequently their solubility. They are distinguished from the nodules of the Ardennes by their greater solubility in acetic acid. They are only fit for conversion into superphosphate.

	Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
22.	Phosphate of Ain (Bellegarde)	16·51	4·38	26·52	0·00	0·00
23.	Rhone Valley (fossils of the Gault)	23·00	5·88	25·56	0·00	0·00
24.	Phosphorite (Nassau)	31·74	7·10	22·40	0·00	0·00
25.	Coprolite (Cambridge)	23·80	5·20	21·84	2·25	9·46
26.	Navassa phosphate	30·62	4·95	16·47	4·73	15·44
27.	Nivernais phosphate	22·20	3·15	14·19	1·35	6·08
28.	Apatite (Caceres, Spain) ..	31·14	4·10	13·16	0·00	0·00
29.	Apatite (Canada)	32·01	trace	trace	0·00	0·00

The phosphates of Bellegarde, of the Rhone, and Nassau, approach the type of the Ardennes nodules by their solubility in oxalate of ammonia and their insolubility in acetic acid. That of Navassa resembles the phosphates of the Garonne. Cambridge coprolite and Nivernais phosphate belong to the type of the bone products.

Oxalate of ammonia enables us to class phosphates in a series closely approximating to that of their relative assimilability. The action of acetic acid, less powerful and general, enables us to seize some distinctions which the oxalate fails to indicate.

It is evident that the agricultural value of phosphates for use in an undissolved state depends more on their solubility, and consequent assimilability, than on their percentage of phosphoric acid.

CONVERSION OF THE SULPHATES OF THE ALKALIES INTO THE CARBONATES, TARTRATES, &c., IN THE MOIST WAY.

By J. LAWRENCE SMITH.

Having had occasion more than once to convert small quantities of the sulphates of the alkalies into carbonates, I have for several years employed a process that has been found both certain and convenient: in some recent investigations it has been used, and as it has never been described it may not be unimportant to explain the nature of the process and its results. The agent used to produce the conversion is carbonate of baryta, made by precipitation: where precise results are required the carbonate should be prepared by carbonate of ammonia. The manner of producing the decomposition is as follows:—Dissolve the sulphate of potash in water, using about 20 or 30 grms. of water to every gramme of the sulphate, and saturate the solution with carbonic acid by passing a current of carbonic acid into it; or, what is better, dissolve in the beginning the sulphate in water already saturated with carbonic acid; now add to this solution precipitated carbonate of baryta, in the proportion of about 1½ of the carbonate to 1 part of the sulphate. It is always best, in adding the carbonate, to rub it up in a mortar with a little water, so as to form a thick cream, for by so doing it mixes well in the solution.

This operation is performed in a bottle that can be well corked with a cork or gum stopper; now agitate the bottle frequently, or, what is still better, attach it to a piece of machinery that will agitate the bottle. Many laboratories have such, and it is a very useful one in many experiments. In a longer or shorter space of time, the decomposition will be completed, pour the solution into a capsule and heat to the boiling-point; the solution will then contain only carbonate of potash.

The reaction is readily understood. The carbonic acid in the water dissolves a little carbonate of baryta, which is immediately re-precipitated in the form of sulphate, carrying down a portion of the sulphuric acid of the soluble sulphate, and replacing the same with carbonic acid; this is rapidly repeated through the agency of the free carbonic acid, until the decomposition of the sulphate is complete.

Among many experimental results, I will give the following;—Five grms. of the sulphate of potash, dissolved in carbonic acid water, to which was added 7 grms. of precipitated carbonate of baryta, after four and a half hours' shaking (being attached to a suitable piece of machinery), on testing showed not a trace of sulphuric acid, care being taken to wipe the neck of the bottle near the end of the stopper before pouring out the liquid.

Other experiments, varying in proportion, gave similar results. I tried to substitute the natural for the precipitated carbonate of baryta, but with very unsatisfactory results.

Directions for the Conversion of the Alkaline Sulphates into Tartrates, Oxalates, &c.—As the tartrate and oxalates of baryta are but very slightly soluble in water, we cannot form the alkaline salts of these acids by direct double decomposition of the sulphates of the alkalies and the tartrate, &c., of baryta, as in forming the alkaline chlorides from the sulphates; but it is easily done by the following indirect process:—

Add to the alkaline sulphates in solution, in a porcelain capsule, carbonate of baryta rubbed up into a thick cream, in the proportion of about 5 of the sulphate to 7 of the carbonate of baryta; heat the mass, and add, little by little, the requisite quantity of tartaric or oxalic acid. Solution of the baryta and precipitation of the sulphuric acid take place rapidly, and the decomposition is soon completed.

I have used this process of forming the bitartrates in the process of separating potassium, rubidium, and cæsium, that were in the form of sulphates.

The Carbonates of the Alkalies can also be formed by first forming these organic salts from the sulphates, evaporating the solution to dryness, and burning the residue; in fact, I frequently find it more convenient to convert the sulphates of the alkalies into the carbonates by this last instead of the first process. And, finally, I would remark that, where magnesia is present with the sulphates, this is also separated from the alkalies.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 19, 1873.

Dr. Odling, F.R.S., President, in the Chair.

When the minutes of the preceding meeting had been confirmed, and the donations made to the Society announced, the name of John Douglas, Esq., was read for the first time. For the third time, those of Messrs. Walter Odling, Archibald Kitchin, James Emerson Reynolds, and Robert Wild, who were then balloted for and duly elected.

The first paper, by J. H. Gladstone, F.R.S., and

A. Tribe, entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies*" (III. "On Normal and Isopropyl Iodides"), was read by Dr. Gladstone. The action of isopropyl iodide on the dry couple at 50° commences after a few minutes, gases are evolved, and the liquid residue in the retort, when strongly heated over a flame, evolves more gas, and at the same time a small quantity of a liquid distils over, apparently containing zinc-isopropyl. As it had been found that more zinc-amyl was produced from the corresponding amyl compound when the contents of the flask were distilled *in vacuo*, the same method was adopted with the isopropyl iodide; and in this case, also, the product obtained was considerably larger. Careful examination and analyses of the gases evolved showed that they consist of nearly equal volumes of propylene, C_3H_6, and hydride of propyl, C_3H_8. The two reactions, $Zn+2C_3H_7I=ZnI_2+C_3H_6+C_3H_8$ and $2Zn+2C_3H_7I=ZnI_2+Zn(C_3H_7)_2$, go on simultaneously at 50°, and when heated to 130° most of the $Zn(C_3H_7)_2$ splits up into $Zn+C_3H_6+C_3H_8$. As was to be expected, the action of the couple on the iodide in the presence of water or alcohol gave propyl-hydride, C_3H_8, the action being more rapid with the alcohol. Experiments similar to the above were also made with zinc-foil and granulated zinc, but in both cases the action was very much more sluggish, and required a higher temperature than when the couple was employed. In the investigations with the normal propyl-iodide it was found necessary to heat the iodide with the dry couple to 80° before any action took place; at 109° the action was much more rapid, and but little gas was evolved. On strongly heating the product in a current of carbonic anhydride, a large quantity of zinc-propyl passed over, which, on rectification, distilled almost entirely between 146° and 148°. When pure, it is a colourless mobile liquid, slightly denser than water, and boiling at about 146°; exposed to the air, it takes fire spontaneously and burns with a white flame. The action of the couple on the normal iodide in the presence of water or alcohol yields propyl-hydride, but the action is much less energetic than in the case of the isopropyl compound. These results entirely agree with the evidence already existing of the comparative instability of the isopropyl compounds. The authors conclude with some additional notes on the couple, describing the most advantageous way of preparing it.

The President, having thanked the authors for their valuable communication, enquired whether the copper took any part in the reaction, or whether alloys had been tried, to which Mr. Tribe replied that the copper had no direct action, and that brass had been tried by Dr. E. T. Thorpe, but was without effect.

The next paper, "*On the Influence of Pressure on Fermentation*" (Part II. "The Influence of Reduced Atmospheric Pressure on Alcoholic Fermentation"), was read by the author, Mr. Horace T. Brown, who, after referring to his former paper, proceeded to describe the methods employed, and the precautions necessary to ensure concordant results in ascertaining the amount of alcohol and carbonic anhydride produced by the fermentation of malt-wort and solutions of cane sugar under diminished pressure. He prefers determining the carbonic anhydride by the loss of weight, or by absorption by potash and soda-lime, as being more accurate than the measurement of the gas evolved. A consideration of the tabulated results obtained in this way shows that diminished pressure retards the progress of the alcoholic fermentation in a remarkable way, although there does not seem to be any simple relation between them. It is certain, however, that under diminished pressure less sugar is decomposed than during an equal time at the ordinary pressure, and that the proportion of the carbonic acid to the alcohol produced is greater. This difference was not due to any injury of the yeast cells caused by the removal of the pressure, but appears rather to be an exemplification of Sorby's law, "that pressure weakens or strengthens chemical affinity, according as it acts against or in favour of the change of volume," since the author has proved that there is a decided contraction in volume during the alcoholic fermentation. The formation of acetic acid noticed in Part I. of this memoir the author finds to be derived directly from the sugar.

After the President had thanked the author in the name of the Society,

Mr. Beanes said he would like to hear from the author of the paper whether he had tried fermentation under pressure, because in July last he (Mr. Beanes), during some investigations on saccharine solutions, had occasion to place a sacccharine solution of 1050 sp. gr., while in a state of fermentation, under a pressure of 36 atmospheres for two days. He found, at the end of that time, on testing it, it marked 1030 sp. gr.; while another portion of the same liquid, which had not been under pressure, marked 0·996. He thought it peculiar that the same results, viz., a decrease of fermentation, as described by the author of the paper, should be obtained by a partial vacuum, while he (Mr. Beanes) had obtained the same result by an increase of pressure.

A paper "*On Cymene from Different Sources Optically Considered*" was then read by the author, Dr. J. H. Gladstone, in which he communicated the results of his optical examination of the cymenes from various sources, recently described by Dr. C. R. A. Wright, which are practically the same for each, their specific refractive energy being 0·55, and their mean refraction equivalent 75·1, the difference of the extremes not being greater than that usually observed between different specimens of the same hydrocarbon. This equivalent, calculated with the common refraction equivalents for carbon (5) and hydrogen (1·3), would give 68·2; thus all these specimens of cymene showed a higher equivalent characteristic of the great aromatic group. This is particularly interesting, as some of them were prepared from substances which do not exhibit this abnormal influence on light, affording additional evidence that the retarding power of the carbon in such bodies as these does not arise from any particular internal structure capable of being transmitted from one compound to another.

After the usual vote of thanks to the author, Dr. Armstrong observed that Landolt had found that, although the refraction equivalent was too high in aromatic bodies when calculated from the empirical formula, yet if in the rational formula the ordinary value for carbon was taken for the substituted radicals, and a higher one for the C_6 in the benzol nucleus, concordant results were obtained.

Dr. Gladstone replied that he believed he was the first to point out this, but at present, although it was true for certain compounds, more data were necessary to fix the value for the carbon in the nucleus.

Dr. C. R. A. Wright said it was probable a correlation between this and other physical properties of bodies would be found, as, for instance, in the different amount of heat given out by isomeric hydrocarbons on combustion; although the results were at present incomplete, he had found this to be the case with those of the series $C_{10}H_{16}$.

A "*Note on the Action of Bromine on Alizarin*," by W. H. Perkin, F.R.S., was then read by the author. Bromine does not act readily on dry alizarin; but, when the two substances are heated to about 170° with carbon disulphide, a brominated alizarin is produced, which, after crystallisation from glacial acetic acid, is obtained in tufts of orange-red coloured needles having the composition $C_{14}H_7BrO_4$. It dissolves in caustic alkalies with a blue-violet colour, similar to that obtained with alizarin, and giving a similar absorption-spectrum. Bromalizarin dyes mordanted fabrics a redder violet with iron, and a browner red with alumina mordants, than is obtained with pure alizarin. Heated with acetic anhydride, it forms *diaceto-bromalizarin*, $C_{14}H_5Br(C_2H_3O)_2O_4$, a yellow crystalline substance.

After the usual vote of thanks, a memoir "*On some Oxidation and Decomposition Products of Morphine Derivatives*," by E. L. Mayer and C. R. A. Wright,

D.Sc., was read by the latter. The authors state that, when apomorphine hydrochloride is heated with an excess of a solution of potassic hydrate, the precipitate at first produced is rapidly dissolved, and the solution acquires a dark colour, from absorption of oxygen. On acidifying it with hydrochloric acid and agitating with ether, a peculiar colouring matter is extracted; the ethereal solution, agitated with an alkaline solution, colours the latter grass-green, and on neutralising with hydrochloric acid indigo-blue flakes are precipitated, having the composition $C_{40}H_{34}N_2O_7$. Diapomorphine and deoxymorphine also yield this blue product when treated with potassic hydrate, but the "tetra" series and the monomorphine derivatives do not—the latter giving methylamine and pyridine, the "tetra" bodies methylamine only and no pyridine. A note to this paper, by Dr. Wright, gives the properties of some colouration products obtained as precipitates by the treatment of certain codeine and morphine derivatives with argentic nitrate and nitric acid. He mentions, as a remarkable fact, that the mother-liquors from which they had been deposited when distilled with caustic potash, yielded methylamine in the case of the morphine compounds, and none in the case of the codeine derivatives, although codeine is methyl-morphine.

Thanks having been returned to the authors for their paper, Mr. R. Warington read his communication "*On the Decomposition of Tricalcic Phosphate by Water.*" The author, after noticing that it had been observed long ago that the mono- and di-calcic phosphates are decomposed when boiled with water, drew attention to the fact that the tricalcic salt is likewise decomposed under similar circumstances. On boiling carefully-washed pure tricalcic phosphate with distilled water for two hours, the solution becomes distinctly acid, and on pouring off the water, and repeating the process ten or twelve times, a compound was at last obtained which had the composition $3(Ca_3P_2O_8)CaOH_2O$, corresponding to apatite, in which the fluoride or chloride of calcium is replaced by the hydrate. The author concluded his paper by some remarks on the solubility of tricalcic phosphate in cold water.

The President then thanked the author for his paper, and for drawing their attention to the formation of this quasi-apatite.

Mr. Warington, in reply to a question of Mr. J. Newlands, said that the pure tricalcic phosphate was prepared from a solution of disodic phosphate, to which an equivalent of ammonia had been added by precipitating it with pure calcic chloride.

Dr. H. E. Armstrong then read a paper entitled "*Communications from the Laboratory of the London Institution*" (No. XII. "On the Nature and some Derivatives of Coal-Tar Cresol," by H. E. Armstrong and C. L. Field. This investigation has for its object the comparison of the haloid and nitro derivatives of cresol and phenol; and for this purpose the authors converted the crude coal-tar cresol, boiling between 190° and 205°, first into the sulphonic acids, and then into the corresponding potassic salts, of which they have succeeded in isolating two, viz., a sparingly soluble one, $C_7H_7O(SO_3K)+2$ aq, and a very soluble salt, $C_7H_7O(SO_3K)$; the former of which yields a very difficultly soluble baric salt when precipitated with baric chloride, and is doubtless identical with Engelhardt and Latschinoff's paracresol-sulphonic acid. The mother-liquors appear to contain a third salt, which has not yet been examined. Both these acids yield mononitro derivatives by the action of nitric acid, which are converted into dibromonitrocresols by treatment with bromine. When the crude cresol is acted on by dilute nitric acid, and the product distilled in a current of steam, crude nitrocresol passes over as a yellow oil, whilst a black residue is left in the retort. The oil readily yields a dinitrocresol melting at about 82°, and forming magnificent red potassium and sodium compounds; it is apparently identical with the dinitrocresol obtained by the action of nitrous acid on toluidine.

The eighth communication was "*On a New Tellurium Mineral, with Notes on a Systematic Mineralogical Nomenclature,*" by J. B. Hannay. Whilst examining a specimen of arsenical iron pyrites, the author discovered in it some metallic tellurium, and also a substance in scales resembling specular iron ore. The latter, on examination, was found to contain arsenic, tellurium, and sulphur, in the proportions corresponding nearly to the formula $Te_2As_2S_7$. After a few remarks on the want of a systematic nomenclature in mineralogy, the author calls the new mineral "arsenotellurite," proposing to name minerals according to the principal constituents—thus, for example, limestone would be "calcite;" and when there are many minerals having the same principal constituents, to add a distinguishing prefix—thus, agate would be called "concentric ferruginous silicite," and so on. A long list of minerals, with the proposed new names, is appended to the paper.

The following paper, a "*Note on Relations among the Atomic Weights,*" by J. A. R. Newlands, was then read by the author:—In the June number of the *Journal of the Chemical Society* is a paper by L. Meyer, "On the Systemisation of Organic Chemistry," in which reference is made to M. Mendelejeff as having shown that certain properties of the elements appear "as a regular periodical function of the atomic weight, if the elements are arranged in the natural system, or according to the numerical values of their atomic weights." Now, in a paper read before this Society on March 1st, 1866, I showed that, when "the elements were arranged in the order of their atomic weights, a simple relation existed between them, those belonging to the same group standing to each other in a relation similar to that between the extremes of one or more octaves in music." I had also previously published the same statement in the Chemical News, vol. x., p. 94, and on other occasions. As my paper was not printed in the *Journal of the Chemical Society*, and therefore a question of priority may arise, I have to request, as a simple matter of justice, the insertion of this brief note in the Society's *Journal.*

The President said the reason why Mr. Newlands's paper on this subject in 1866 had not been published by the Society was that they had made it a rule not to publish papers of a purely theoretical nature, since it was likely to lead to correspondence of a controversial character.

The President then adjourned the meeting till after the recess, congratulating the members on the flourishing state of the Society and the number and importance of the papers which had been read there during the session.

CORRESPONDENCE.

ACETAMIDE AND ETHYLATE OF SODIUM.

To the Editor of the Chemical News.

Sir,—It is evident that Mr. Wanklyn does not know what he is talking about when he makes such a communication as that which I read in your last number, p. 302. Those acquainted with the substance of my paper know that, when sodium alcohol and acetamide are heated together, less than 5 per cent of the ammonia obtainable from acetamide is given off, and that the amount of ammonia depends upon how far moisture gains access to the materials. The conclusions I arrived at were that perfectly dry acetamide and dry sodium alcohol yield no ammonia of any kind, neither do they produce a new compound. This was not apparent from your reporter's notice; I therefore ask you to be so good as to publish this.—I am, &c.,

W. N. Hartley.

King's College, London,
June 22, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 2, 1873.

Action of the Chief Derivatives of Amylic Alcohol upon Polarised Light.—I. Pierre and E. Puchot.—Amylic alcohol has an action upon polarised light resembling that of a solution of sugar of 1·4 per cent, but of an inverse direction. The authors found, in all the experiments to which they submitted the pure amylic alcohol of fermentation, no indication of the second amylic alcohol pointed out by Pasteur. The action of ordinary amylic alcohol upon polarised light is increased one-third by the addition of about 6 per cent of water. Amylic alcohol, reproduced from its ethers, or obtained as the residue of an incomplete oxidation, does not appear to have undergone any appreciable modification either in the direction or the intensity of its action upon polarised light. This is not the case with its ethers, nor with the compounds formed under the oxidising influence of a mixture of sulphuric acid and bichromate of potash, along with the necessary amount of water. The first of these oxidation products, amylic aldehyde, turns the plane of polarisation in an opposite direction; in the same, namely, as would be produced by crystallised sugar. With the pure aldehyde this deviation is equal to that which would be produced by a solution of crystallised sugar at 1 per cent. Its degree of purity has a great influence on the extent of deviation. A sample of crude aldehyde, saturated with water, gave a deviation three times greater than does the pure substance. The presence of the water was, however, found not to be the cause of this increased action, since a sample of pure aldehyde saturated with water exerted a rotatory power decidedly inferior to that of the anhydrous aldehyde. The second product of oxidation, valerianate of amyl, (isomeric with the aldehyde above mentioned) causes a deviation in the same direction—but seven times greater—equal to that of a solution of crystalline sugar of 6·6 per cent. The results obtained with the amylic compounds are represented in the subjoined table; the sign + being attached to the deviations similar in direction to crystalline sugar, and − to those in the inverse direction:—

	Sp. Gr. at 0° C.	Boiling-point. Degrees.	Deviation. Degrees.
Valerianate of amyl ..	0·8740	190·0	+ 40·0
Butyrate of amyl	0·8769	170·3	+ 8·5
Valerianate of butyl ..	0·8884	173·4	+ 3·0
Valerianate of propyl ..	0·8862	157·0	+ 9·0
Valerianate of ethyl ..	0·8860	135·5	+ 12·5
Valerianate of methyl ..	0·9005	117·5	+ 8·5
Valerianic acid (monohydric)..	0·9470	178·0	+ 5·0
Anhydrous amylic alcohol	0·8255	130·0	− 8·5
Do. do. with 6 per cent water	—	—	− 11·0
Amylic aldehyde (pure) ..	0·8209	92·5	+ 6·0
Do. do. crude (hydrated	—	—	+ 18·0

Two active isomeric bodies like valerianate of butyl and butyrate of amyl are not necessarily equal in rotatory power. There does not seem to exist any definite relation between the rotatory power of two isomeric active bodies and their respective specific gravities.

Detection and Determination of Sulphate of Lead in Commercial Chromates of Lead.—E. Duvillier.—The methods used to decide on the purity of a chromate of lead do not indicate whether sulphate of lead be present or absent. The author heats gently, in a flask of sufficient size, 1 part of the sample of chromate with 2 to 3 parts of nitric acid at 1·420° sp. gr., 1 to 2 parts of water, and ¼ of alcohol. The reaction is very strong, and must be moderated by reducing the heat. When the violent action has subsided, heat is still applied till all nitrous fumes have disappeared. In the flask will be found a violet liquid—a mixture of nitrate of lead and nitrate of chrome—and a white precipitate of nitrate of lead, along with which sulphate of the same metal may be present. Water is added and the whole boiled. If no sulphate is present the whole dissolves; but otherwise sulphate of lead remains insoluble. To determine its amount the whole is evaporated to dryness to expel nitric acid, and the products of the oxidation of alcohol, care being taken not to heat so strongly as to decompose the nitrate of chrome. On treating the residue with water the sulphate is left undissolved. This method is applicable to all chromates.

Action of Nitric Acid upon Chromate of Lead.—E. Duvillier.—In allowing nitric acid, diluted with 1 to 2 volumes of water, to act at the boiling-point upon pure chromate of lead the liquid took the colour of chromic acid, and preserved it on cooling, although the bulk of the chromate of lead remained unchanged. On concentration crystals of nitrate of lead were deposited. The mother-liquor evaporated to dryness yielded a solution of chromic acid nearly pure, but representing a very small part only of the chromic acid present in the quantity of chromate employed. The action of the nitric acid is, therefore, analogous to its behaviour with chromate of baryta. With the latter, however, the amount of water is immaterial, whilst if water be added to a solution of chromate of lead in nitric acid this salt is precipitated. On treating the chromate of lead with double its weight of nitric acid we obtain a solution of chromic acid containing only 2 per cent of lead oxide. Nitric acid, therefore, resolves chromate of lead into chromic acid and into nitrate of lead, which is precipitated at a boiling heat in presence of the excess of nitric acid employed.

On a Base Isomeric with Piperidine, and on the Nitro Derivatives of the Hydrocarbons of the Formula $C_{2m}H_{2m}$.—H. Gell.—Meyer and Stuber have lately prepared isomeric compounds of the nitrogenous ethers formed by wood-spirit, alcohol, and oil of potatoes. These new substances behave like nitro derivatives of hydrocarbons of the general formula $C_{2m}H_{2m+2}$. This discovery of these compounds tends to disprove the essential difference which had been assumed between these carbides and those of the aromatic series, $C_{2m}H_{2m-6}$, the only group whose nitro derivatives were known. The author endeavoured to obtain analogous compounds of another family, still resulting from the substitution of an equivalent of hyponitric acid for one of hydrogen. He sought to prepare the nitro derivatives of the hydrocarbons $C_{2m}H_{2m}$. Having added to nitrethane the quantity of potassa dissolved in alcohol necessary for its transformation into potassic nitrethane, it was placed in contact with an equivalent of iodide of allyl. On adding water to the filtrate an oily liquid was obtained which could not be purified for analysis as it was decomposed on volatilisation. On treating it with hydrochloric acid and fragments of zinc the insoluble oil disappeared, and on distilling the residual liquor with an excess of potassa a colourless liquid was obtained which, on the addition of some fragments of potassa, gave an odour of piperidine. The new substance differs from that base in several important respects. It boils at 85°, and its isomer at 106°. It is soluble in water and alcohol, and combines energetically with acids. If poured upon bisulphide of carbon it gives rise to a brisk reaction, but the liquid does not crystallise

on cooling like piperidine. The author concludes that it is a primary mono-amine of the formula—

$$\left.\begin{matrix} C_{10}H_9 \\ H \\ H \end{matrix}\right\} N$$

Note on the Transit of Venus in 1882.—M. Pinseux.—The author gives a number of particulars as to the circumstances of observation. He points out that the shortest transit will be observed in the neighbourhood of New York, and the longest (in accessible regions) in Terra del Fuego and adjacent islands, the difference of duration being about sixteen minutes. The most retarded ingress will be observed in Canada and New Britain; the most accelerated in the island of Kergualen, between which and Montreal the difference will be more than fifteen minutes. The most accelerated egress will be observed in the Antilles and Euzana; the most retarded in the eastern part of Australia, *e.g.*, Sydney; the difference from the time of ingress being about fifteen minutes. The determination of parallax by observations of contact will be in less advantageous circumstances than in 1874. In the latter case, with accessible regions the differences of duration of transit reach twenty-six minutes, the differences of times of ingress twenty-one minutes, and those of times of egress eighteen minutes; while in 1882 the differences will be reduced, the first to sixteen and the two others to fifteen minutes. Instead of observing the hours of contact, however, the parallax might be deduced from measurements made during the transit, and giving at various instants either the angular distances of the centres of Venus and of the sun, or the angle of position of Venus. M. Puiseux illustrates these points.

Trial during a Solar Eclipse of the New Spectroscopic Method Proposed for the Approaching Transit of Venus.—P. Secchi.—His method is as follows:—A highly dispersive direct-vision prism is placed about 25 c.c. before the slit of an ordinary spectroscope supported on the same tube. This gives in the plane of a slit a coloured image of the sun in the form of a very impure spectrum. The rays transmitted thence through the spectroscope form in the field of the small telescope a very distinct solar image, in which not only the border of the disc, but also the spots and the faculæ are quite visible. The sun is seen, in fact, as with coloured glass. When the image is received so that it is formed by red rays, then by putting the Fraünhofer line C near the sun's border at the exterior, one sees the chromosphere as a bright line separated from the solar disc by a distance equal to the height of the chromosphere; but one may at will displace this line according to the part of the chromosphere to be observed, even to contact with the sun's border. Hence, when the dark star covers the chromosphere in points situated in the field of the telescope, one will see this bright line interrupted, and be advised that the star approaches contact. One may then follow its movement by placing the slit near the border, and as the border itself is distinctly seen may estimate very exactly the instant in which (the line disappearing) the border of the dark star eats into the disc of the bright star. P. Secchi observed the recent eclipse thus, and found the results fully up to his expectations. P. Rosa and P. Ferrari also made observations at the same time; the former with a Weil refractor, magnifying 80 times, the latter with a Cauchoix telescope magnifying 120 times; and from comparison of the mean result with P. Secchi's it appears that first contact was anticipated by P. Secchi by 11·9 seconds, while the egress was retarded by 12·2 seconds; the method gives more precision. Comparing his results with those of M. Respighi, who used an ordinary spectroscope according to a method proposed by Zollner, P. Secchi finds M. Respighi in advance of him at the commencement and behind him at the close, the difference of duration being 34·2 seconds; but he gives reasons for thinking this result excessive; chiefly the sun's border seen by Zollner's method is imperfectly defined. The writer makes these suggestions:—(1) For the first notice of the phenomenon use the ordinary spectroscope as for observation of protuberances; (2) having ascertained the ingress of Venus on the chromosphere mount the prism before the slit to obtain a distinct and direct solar image in the field of the spectroscope (an objective prism is preferable to a direct-vision prism); (3) for the second interior contact use either this method or the ordinary.

Action of the Electric Fluid on Flames, Liquids, and Powdery Substances.—Second note by M. Neyreneuf.—The writer examined flames containing no solid particles. In pure hydrogen there was a sensible attraction by a negative print; in carbonic oxide and sulphide of carbon the attraction was more marked, and to both points. Alcohol behaves like ordinary gas. Retreat of the flame is most marked with essence of terebenthin (burnt in a lamp). If the electric point be directed normally to the surface of liquids in a conducting cylindrical capsule an umbilicus is produced for both fluids in water, oil, sulphide of carbon, essence of terebenthin. With badly conducting liquids, if one withdraws the point after having immersed it some millimetres, a liquid cone remains adherent as long as the electricity passes. Few powders give distinct effects. The blue sand used for drying with is best. Either electric point held a little way off produces centrifugal effects, while if the negative point be held very near there is a centrifugal aspiration. On contact one may, as with liquids, raise and maintain a cone of grains during passage of the current.

Molecular Rotation of Gases.—M. Hinrichs.—In the molecular theory of gases only the movements of translation have been considered, and as if these molecules were small globes perfectly elastic; whereas they are composed of several atoms held at some distance from each other. The author deduces from mechanical laws that these non-globular molecules have a movement of rotation about the natural and principal axis, for which the moment of inertia of the molecule is a maximum. A knowledge of the moment of inertia of molecules has led him to calculate the boiling-points of isomers, and details will be given in his forthcoming work on molecular mechanics.

General Results of Analysis of the Glyserian Springs in the Island of San Miguel (Azores).—M. Fouqué.—Chemical analysis reveals in all the waters of San Miguel the original existence, but in various proportions, of saline compounds identical with those obtained by condensing the fumes of a volcano in action, or lixiviating cold lava; and also the presence of the most common volcanic gases.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
May 26, 1873.

Aromatic Amide Acids with Alcohol Radicals.—Peter Griess.—The author has previously shown that in certain aromatic amide acids 1, and also 2 atoms of hydrogen can be easily replaced by alcohol radicals. He has since attempted to substitute a third atom in the same manner, and in some cases successfully. The compounds thus obtained differ very essentially from the amide acids previously described, and containing 1 or 2 atoms of an alcohol radical. The latter still possess the double attributes of acid and base, whilst the amido acids with 3 atoms of an alcohol radical have entirely lost the power of forming metallic salts, and, strictly speaking, cannot be classed as acids. They behave more like organic bases, and seem most closely connected with a little known class of basic bodies, to which Liebreich's oxyneurine and Scheibler's betaine, $C_5H_{11}NO_2$, belong. The first of the compounds obtained, trimethyl-benzo-betain, $C_{10}H_{13}NO_2$, forms small white acicular crystals containing 1 atom of crystalline water, deliquescent in the air, insoluble in ether, very soluble in alcohol, of bitter taste, and without reaction upon vegetable colours. If heated alone to fusion

it is transformed into its isomer, dimethyl-amido-benzoic acid—

$$C_6H_4\left\{\begin{array}{l}CO_2CH_3\\N(CH_3)_2\end{array}\right.$$

a liquid of faintly aromatic odour and yellowish colour, insoluble in water. Another compound of this class, trimethyl-anisbetaine, $C_{11}H_{15}NO_3$, forms large vitreous prisms, containing 5 atoms of crystalline water. It is easily soluble in water, especially if hot, sparingly in alcohol, and insoluble in ether. At elevated temperatures it is entirely resolved into dimethyl-amido-anisic acid—

$$C_6H_3\left\{\begin{array}{l}CO_2\ CH_3\\\ O\ \ CH_3\\\ N\ (CH_3)_2\end{array}\right.$$

a yellowish fluid of faint aromatic odour, insoluble in water, and boiling at 288°.

On Diallyl, and on Attempts to Prepare Allyl-Benzol.—R. Wagner and B. Tollens.—The authors have attempted unsuccessfully to substitute allyl for hydrogen in benzol. In course of their researches they obtained the tetrabromide of diallyl, $C_6H_{10}Br_4$, in four-sided prisms of camphor-like odour, and fusing at 62·5° to 63·5°. As its melting-point is given at 37° the cause of the discrepancy was examined. The authors prepared diallyl by Oppenheim's method (heating the allyl-iodide of mercury with solution of cyanide of potassium) and obtained a product boiling at 58° to 60°. On the addition of bromine a product was obtained, which behaved quite similarly to that prepared by means of the bromide of allyl.

Note on the Detection of Sulphur Compounds by Means of the Blowpipe.—B. Tollens.—One of the simplest methods of testing substances for sulphur compounds is to heat them upon charcoal with soda in the inner blowpipe flame. Remarkably enough it is nowhere pointed out that this test must be performed not with the flame of coal-gas but with an oil-lamp or a candle. Coal-gas contains so much sulphur that soda upon which its flame has been driven for a minute blackens silver strongly, which is never the case with the flame of a candle.

Crystallographic Examination of the Derivatives of Naphthalin.—C. Hintze.—The author, having undertaken a revision of Laurent's labours in the same field, which he pronounces "totally useless for science," remarks that in the substitution of chlorine for hydrogen in the tetrachloride of naphthalin the angles of one crystal zone ($p:p$) remain almost equal, just as has been shown by Groth to be the case with the derivatives of benzol. Here also, therefore, the morpho-trophic action extends only in certain crystallographic directions, with the distinction that this action is stronger in the derivatives of benzol than with those of naphthalin. This fact agrees perfectly with Groth's view that the morpho-trophic action of a substance depends not alone on its chemical nature, but on the structure of the compound into which it enters by way of substitution. Elements are often isomophous in complex compounds, but not in those of more simple structure.

On Œnanthylic Acid and Normal Heptyl Alcohol.—H. Grimshaw and C. Schorlemmer.—Comparative examination of the œnanthylic acid obtained from œnanthol and that prepared from normal heptane gave the following results. The ethylic ether of the acid from œnanthol is a liquid of a pleasant fruity smell, boiling at 186° to 188°. The barium salts of the two acids have the same crystalline form and the same solubility in water. The calcium salts contain 1 atom of crystalline water, and are equally soluble, both forming slender needles arranged in tufts. The copper salts are obtained as somewhat soft precipitates, which on standing become granular. They are insoluble in water, but soluble in absolute alcohol. On evaporating the solutions the salt obtained from œnanthol separates out in small green needles or prisms. On the other hand, that obtained from heptane separates first in a liquid state and then dries up to an amorphous mass. The copper salt of Franchimont's heptylic acid was likewise separated at first in little drops, which congealed to crystals. In other respects the compounds obtained by the authors were very similar to the corresponding salts of heptylic acid. Whether the distinctions observed in the cupric salts are essential must be determined by further experiment. Œnanthylic acid indubitably belongs to the normal series, and as its aldehyde is readily obtained it forms the best material for preparing the normal heptyl compounds hitherto scarcely known.

Affinity of Bromine for Oxygen.—H. Baumhauer.—Thomsen, in an essay on the affinity of oxygen for chlorine, bromine, and iodine, has concluded from thermo-chemical determinations that—in opposition to the prevailing opinion—the affinity between the constituents of bromic acid is considerably less than that between the constituents of chloric acid. This result he pronounces unexpected. In fact several manuals of chemistry state that bromine expels chlorine from chloric acid with formation of bromic acid (see Roscoe's "Outlines of Chemistry"). The author heated a solution of chlorate of potassa with bromine, but on evaporating the residue no bromate could be detected. Neither was any bromate of potassa formed on allowing bromine water to act upon chlorate of potassa with the addition of a little nitric acid—an adjunct which, under parallel circumstances, promotes the formation of iodate of potassa. It seems, therefore, decided that the affinity between oxygen and bromine is less than that between oxygen and chlorine.

Contribution to the History of Sulpho-Urea.—M. Nencki.—If a cold saturated aqueous solution of sulpho-urea is mixed with a solution of cyanide of mercury in equivalent amount, a crystalline double salt is thrown down which, when washed and dried over sulphuric acid, yielded results agreeing with the formula—

$$CSN_2H_4C_2N_2Hg.$$

This compound is sparingly soluble in cold water, and cannot be re-crystallised from hot water, since on heating the aqueous solution a black precipitate of sulphide of mercury is formed, and an odour of hydrocyanic acid is given off. If the solution is boiled till all sulphur is deposited the filtered liquid yields on evaporation crystals of dicyanamide. If sulpho-urea is gently heated with anhydrous acetic acid it dissolves and yields monoacetylic sulpho-urea in yellowish prisms, which can be obtained colourless by repeated crystallisation. Its composition is—

Carbon	30·50
Hydrogen	5·08
Nitrogen	23·72
Sulphur	27·11
Oxygen	13·56
	99·97

agreeing with the formula $C_3H_6N_2SO$, or—

$$CS(C_2H_3O)H_3N_2.$$

This substance is readily soluble in alcohol and hot water, sparingly in cold water and ether. It melts at 11·5° to a colourless liquid. The aqueous solution has a neutral reaction, and forms with the chloride of platinum a crystalline salt sparingly soluble in water—

$$CS(C_2H_3O)H_3N_22HCl,PtCl_4.$$

If acetylic sulpho-urea is distilled with anhydrous phosphoric acid an oil of a pungent odour, heavier than water, distils over.

Determination of Chloral.—V. Meyer and H. Haffter.—The authors remark that chloral hydrate is often found very impure, whence a simple and accurate method for its quantitative examination becomes needful. With aqueous solutions of alkalies chloral hydrate is completely resolved into chloroform and alkaline formiate according to the equation, $C_2Cl_3H_3O_2+NaOH=CHCl_3+HCO_2Na+H_2O$. 1 equivalent of chloral hydrate neutralises 1 equivalent of soda, or 165·5 grms. of the former require 1000 c.c. of normal solution of soda. If, therefore, a weighed amount

of the sample under examination is mixed with a known excess of normal soda solution, and the remaining excess of soda is determined by titration with standard acid, the soda consumed and the corresponding amount of pure chloral hydrate are found by the equation—

$$x = \frac{(a-b)\ 165{\cdot}5}{1000}\ \text{grm.}$$

a denoting the number of c.c. of normal soda consumed, and *b* the c.c. of normal acid used for titration. If free hydrochloric acid is present as an impurity, it is neutralised by shaking up the aqueous solution with pure carbonate of lime, and expelling the free carbonic acid by prolonged agitation in the measuring cylinder.

Aromatic Phosphorus Compounds.—A. Michaelis.—Two of the aromatic phosphorus compounds, corresponding to those of nitrogen, are peculiarly interesting; phosphoraniline, $PH_2C_6H_5$ and $PO_2C_6H_5$, both of which had not been obtained. The author passed a mixture of the vapours of benzol and chloride of phosphorus through a glass tube filled with pieces of pumice, and heated nearly to redness. The distillate was returned, and again passed over until 1000 grms. of a liquid, boiling at temperatures higher than 80° was obtained. By fractional distillation a colourless liquid, $PCl_2C_6H_5$, was obtained, boiling at 222°. This substance —phosphenyl-chloride— is a very permanent liquid, refracting light strongly, and fuming in the air with an intense odour resembling both phosphuretted hydrogen and hydrochloric acid. It affords the prospect of a new series of interesting aromatic derivatives.

Behaviour of Ozone with Water.—C. Rammelsberg.—Schœnbein, Marignac, and Andrews pronounce ozone insoluble in water; whilst Soret, Meissner, and Houzeau maintain the opposite view. Carius proved that at low temperatures (0·5° to 5°) oxygen gas, rich in ozone, obtained by electrolysis, forms with water a liquid which gives the reactions of ozone. Engler and Nasse have also convinced themselves of the solubility of ozone. The author examines whether ozoniferous oxygen or air when passed at ordinary temperatures through water would give a liquid capable of producing the reactions of ozone. The result showed that when chlorine was absent the reaction with starch and iodide of potassium was obtained very slightly in one case only, and that with indigo and thallium salt not at all. The so-called "ozone water" of Krebs, Kroll, and Co. contains chlorine, and is pronounced by Dr. Jacobsen to be a dilute solution of hypochlorous acid.

Hydrates of Monobasic Acids.—A. Henninger.—A reply to Geuther's claim of priority for the theory of the hydrates of the fatty acids. He quotes the following formula which Geuther has given for acetic acid:—

$$\left.\begin{array}{r} \text{O} \\ \text{IV. H} \\ \text{C IV.} \\ \text{C} \end{array}\right\} \begin{array}{l} \text{H}_2 \\ \text{OH} \end{array}$$

Sequel to Investigations on some New Derivatives of Sulpho-Carbaminic Acid.—H. Hlasiwetz and J. Kachler.—The authors have found that, with the exception of the aniline derivative, their results had been anticipated by Zeise in 1842.

Remarks on Petersen's Essay "On the Constitution of the Benzols." — H. Salkowski.—A controversial-theoretical essay on the supposed position of the lateral groups in the derivatives of benzol.

Occurrence of Arabic Acid (Gum) in the Sugar Beet, and on Gum-Sugar.—H. Scheibler.—This paper is not suited for abstraction. We shall endeavour to give it in full.

Reimann's Färber Zeitung, No. 18, 1873.

This number consists chiefly of receipts for dyeing and printing upon woollen, cotton, silk, and mixed tissues.

Dyeing Straw Hats.—The articles are boiled in a mixture of 1 lb. sulphate of alumina, ½ lb. prepared tartar, ¼ lb. sulphuric acid, to which orchil, extract of indigo, and turmeric are added as required.

Carminate of Lime.—The compound of carminic acid—the colouring principle of cochineal—with lime is, according to Guignet, distinguished by its black colour from the other cochineal lakes, which are mostly violet. There is consequently always a black precipitate formed when a decoction of cochineal comes in contact with a solution of lime, or even with calcareous water. Pure carminic acid does not, indeed, precipitate gypsiferous water. The reason why decoction of cochineal produces this effect is because it is slightly alkaline. The black carminate of lime can be produced by mixing bicarbonate of lime in solution with decoction of cochineal. The black precipitate is probably neutral carminate of lime, insoluble in water and alcohol. An excess of lime colours the precipitate a deep violet. Concentrated acetic acid dissolves the precipitate with a deep red colour.

No. 19.

The number commences with receipts for sizing linen, for producing ponceau and aniline blue on mohair yarns, superior black on cotton yarns, flamed effects on the same material, deep madder red on wool, naphthalin yellow on woollen yarn, reddish drabs on wool, iodine green on woollen yarn, light and dark maize flesh colour and mulberry on cotton, pensé, crimson, Bismarck, drab, and grey on jute.

Black Spots in Grain Dyeing.—Traces of iron should be carefully avoided in all operations with cochineal, as the compounds of this metal with carminic acid are black. Guignet's opinion that the black spots sometimes found on grain dyed goods are derived from carminate of lime is probably erroneous, as the flot in which these colours are dyed is so acid that any carminate of lime would be at once re-dissolved. Such spots the author considers due to iron present as an impurity in the tin mordants.

Birls in Woollen Tissues. — To remove birls Descoubet saturates the cloth with steam, and conducts it through a narrow slit into a chamber filled with hydrochloric acid gas. Here the cloth is passed several times up and down, and is then conducted into another chamber and dried at a somewhat elevated temperature. It is then run into an alkaline bath, which removes all traces of the acid that has destroyed the vegetable matter.

Aniline Red-Violet.—Hobrecker prepares a reddish aniline by treating rosaniline with iodide of methyl and chloride of benzyl, ($C_{14}H_7Cl$). The metallic green acicular crystals, insoluble in water and sparingly soluble in cold alcohol, are rosaniline, in which 3 atoms of hydrogen are replaced by benzyl, $C_{14}H_7$, the whole being combined with 1 atom of iodmethyl.

Patent Mixture for Cleansing Carpets.—In noticing an English patent for cleansing carpets—which, by the way, prescribes 3½ lbs. soda, and 4½ ozs. washing crystals—the editor very properly remarks that a final treatment with dilute oxalic acid would improve the colours.

Impurities in Tin Crystals.—Bronner recommends dyers to prepare their own bichloride of tin from commercial tin crystals, which, he thinks, are rarely contaminated, except with sulphates of soda and magnesia—substances easily detected by means of chloride of barium. The editor points out that tin crystals are often adulterated with alkaline chlorides, forming double salts much less easily detected.

Preparation of Caustic Baryta. — M. Rosenthiel's process is founded upon the decomposition of sulphide of barium dissolved in boiling water by oxide of zinc. Caustic baryta and sulphide of zinc are formed.—*Year-Book of Pharmacy.*

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in utilising waste products obtained in the manufacture of phosphorus, and in the manufacture of certain metallic compounds containing phosphorus. J. H. Player, manufacturer, Birmingham. November 22, 1872.—No. 3501. This invention consists in utilising the gaseous phosphorus compounds obtained in the manufacture of phosphorus by passing the said gaseous compounds through a solution of sulphate of copper; by this treatment phosphide of copper is obtained. The invention further consists in adding phosphorus to copper and alloys of copper thereto for the purpose of giving tenacity and other valuable properties thereto by the use of phosphide of copper instead of uncombined phosphorus, as commonly practised.

Improvements in the mode of and apparatus for treating horny and other analogous animal substances for the purpose of converting them into an elastic substance to be used in place of whalebone, bristles, and for other purposes for which such elastic substance may be applicable. W. Birch, engineer, Penrose Street, Walworth Road, Surrey. November 22, 1872.—No. 3503. The treatment to which the horny substance is subjected (to effect the object of this invention) is a combination of a chemical and mechanical process. The chemical process, which consists in steeping the horny substance in an infusion of sage leaves or plants of that class, is used to soften the substance, and the subsequent mechanical operation is either to flatten, roll out, and extend or mould the softened horny matter, or to disintegrate it into thread.

Improvements in the filtration and purification of fluids, and in the manufacture of manure. David Curror, Wester Craigduckie, Fifeshire, and James Dewar, 15, Gilmore Place, Edinburgh. November 25, 1872.—No. 3529. The features of novelty which constitute this invention are—So using and applying peat (in its natural state, or after being dried or partially carbonised, and either by itself or mixed, or in connection with chalk, lime, sand, earth, or aluminous clay) as a filtering medium or as a discolourising, deodorising, defecating, disinfecting, or absorbing agent or material, that (1) colouring matters in suspension or solution are retained or absorbed, and the fouled water greatly discolourised, clarified, deodorised, defecated, and disinfected, and (2) that the peat (when the fluid passed through it has contained nitrogenous matters) is converted into a valuable manure. This is effected by artificial filtration, the filter bed being made up of ordinary filtering material with a layer or layers of peat of the required thickness laid on the surface of it.

Improvements in manuring, disinfecting, and deodorising. James Raymond Belford, Clifton, Gloucester. November 25, 1872.—No. 3533. This specification describes a manure, and disinfecting and deodorising compound, being a combination of the different salts of ammonia, potash, and soda, sulphates, phosphates, silicates, muriates, &c., in the several proportionate amounts required for the full development of all crops, together with a certain quantity of mineral acids and various phenyl compounds, sulphites, and other antiseptics.

A new or improved industrial manufacture of acetate of alumina, and the treatment of the resulting products. Farnham Maxwell Lyte, chemist, of the firm of Storck and Co., Asnières, France. (A communication from Henri Storck, Edouard Hentsch, Auguste Hentsch, André Lutscher, and Frederic Grininger, constituting the firm of Storck and Co., Asnières, France). November 26, 1872.—No. 3552. The feature of novelty of this invention refers to the manufacturing of acetate of alumina. In carrying out this invention I convert phosphate of alumina into acid phosphate by dissolving it into phosphoric acid. To the liquor I add some acetate of lead in proportionate quantity to that of phosphoric acid therein, that is to say, containing enough lead to precipitate the whole phosphoric acid. Soluble acetate of alumina and unsoluble phosphate of lead are formed. I separate the acetate of alumina by filtration, which I treat afterwards similarly to that obtained by double decomposition with sulphate of alumina for industrial purposes. As to the phosphate of lead, I use it to produce pure phosphoric acid, decomposing it by sulphuric acid or sulphuretted hydrogen, or a phosphate is formed thereof in treating it by an alkaline sulphide, or it may be mixed with charcoal for producing phosphorus by distillation.

Improved process of treating and purifying crude phosphoric acid, and in the production of soluble phosphates, also for the manufacture of phosphorus, and the treatment of certain residues resulting therefrom, and phosphate of alumina. Farnham Maxwell Lyte, chemist, of the firm of Storck and Co., Asnières, France. (A communication from Henri Storck, Edouard Hentsch, Auguste Hentsch, André Lutscher, and Frederic Grininger, constituting the firm of Storck and Co., Asnières, France). November 28, 1872.—No. 3585. The features of novelty of this invention consist—First. In the production of sulphuric acid from phosphoric acid, and certain of its compounds by means of barium and its salts. Second. In the application of phosphoric acid (purified according to this invention) to the manufacture of phosphate of sodium, phosphate of ammonia, and other phosphates, and its employment, as well as the residues in manufactures. Third. In the manufacture of a paste wherewith to charge retorts in the manufacture of phosphorus; the paste is made by evaporating barytated phosphoric acid, and mixing therewith pounded phosphorite or bone-earth and charcoal, and subjected to distillation.

Improvements in the manufacture of sugar, and in apparatus to be used therefor. Alfred Vincent Newton, 66, Chancery Lane, Middlesex. (A communication from Santiago Dod, Havana, Cuba). November 28, 1872.—No. 3588. One part of this invention, which relates to the manufacture of sugar from either the sugar-cane or beet-root, consists in the generation of the steam used in sugar-works (including the supply of the clarifiers, also the working of the pump or pumps, and, if desired, the driving of the engine or engines employed) from the juice itself as a substitute for water, in or during the earliest stages of concentrating the juice, by boiling the latter under pressure in a close vessel or vessels exposed to the direct application of heat, whereby fuel and labour are largely economised. The invention also comprises improvements in the vacuum-pans and other parts of the apparatus employed in the manufacture of sugar.

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